Auditory information and its parameters in health persuasion

Elbert, Sarah

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The development of a tailored smartphone application to support behavior change

Sarah Elbert

This research was funded by ZonMW – the Netherlands Organization for Health Research and Development (grant number 121020021). Financial support for printing this thesis was received from the University of Groningen and the Kurt Lewin Institute.

Printing: Ridderprint BV
Cover & lay-out: Hannique de Jong

ISBN 978-90-367-8241-8 (Paperback version)
ISBN 978-90-367-8240-1 (Electronic version)

rijksuniversiteit
groningen

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Proefschrift

ter verkrijging van de graad van doctor aan de
Rijksuniversiteit Groningen
op gezag van de
rector magnificus prof. dr. E. Sterken
en volgens besluit van het College voor Promoties.

De openbare verdediging zal plaatsvinden op

donderdag 26 november 2015 om 14.30 uur

door

Sarah Pietertje Elbert

geboren op 7 december 1987
te Smilde

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Chapter 1

General Introduction

General Introduction

The consumption of sufficient fruit and vegetables is an important part of a healthy lifestyle and it is found to be fundamental in achieving and maintaining positive health outcomes. For instance, sufficient daily fruit and vegetable consumption can play a key role in the prevention of chronic diseases (Boeing et al., 2012; WHO, 2003): It has been associated with a lowered risk of the development of cardiovascular diseases (He, Nowson, Lucas, & MacGregor, 2007; Joshipura et al., 2001; Ness & Powles, 1997), and small protective effects have been found with regard to specific types of cancer (Steinmetz & Potter, 1996; WCRF/AICR, 2007). In addition, a lowered risk of diabetes type 2 has been found to be related to the intake of green leafy vegetables and fruit (Bazzano, Li, Joshipura, & Hu, 2008; Carter, Gray, Troughton, Khunti, & Davies, 2010). Eating sufficient fruit and vegetables also fits in a nutritional pattern aimed to reduce weight and stay healthy "due to the high fiber content and low energy density" (van Kreijl, Knaap, & van Raaij, 2006). Not only physical health benefits have been reported; research suggests that fruit and vegetable intake is related to mental well-being as well (Rooney, McKinley, & Woodside, 2013). Thus, fruit and vegetable consumption is associated with several potential benefits.

However, low numbers of sufficient fruit and vegetable intake have been reported over the last two decades (van Kreijl et al., 2006). At least 74% of the Dutch adult population does not eat sufficient fruit and this percentage is even higher (86%) for vegetable consumption (van Rossum, Fransen, Verkaik-Kloosterman, Buurma-Rethans, & Ocké, 2011). In addition, similar global patterns are identified: High percentages of people all over the world do not meet the recommendations of eating sufficient fruit and vegetables (Hall, Moore, Harper, & Lynch, 2009; Murphy, Barraj, Spungen, Herman, & Randolph, 2014; WCRF/AICR, 2007).

Indeed, it is recognized that insufficient fruit and vegetable intake is a worldwide issue (Murphy et al., 2014; WHO, 2002). To stimulate people to increase their fruit and vegetable intake, health educational interventions and programs are developed and implemented. Dieticians offer nutritional programs that stimulate the intake of sufficient fruit and vegetables and national health institutions develop campaigns with persuasive messages to eat healthy. Nowadays, Internet-based resources can be considered relevant channels for health interventions as well (Cassell, Jackson, & Cheuvront, 1998; Kratzke & Cox, 2012; Webb, Joseph, Yardley, & Michie, 2010). For instance, tailored persuasive health information or feedback can be applied via websites or smartphone applications ("apps") to assist people in health behavior change (Brug, Oenema, Kroeze, & Raat, 2005; Hebden, Cook, van der Ploeg, & Allman-Farinelli, 2012; Oenema, Brug, Dijkstra, de Weerdt, & de Vries, 2008).

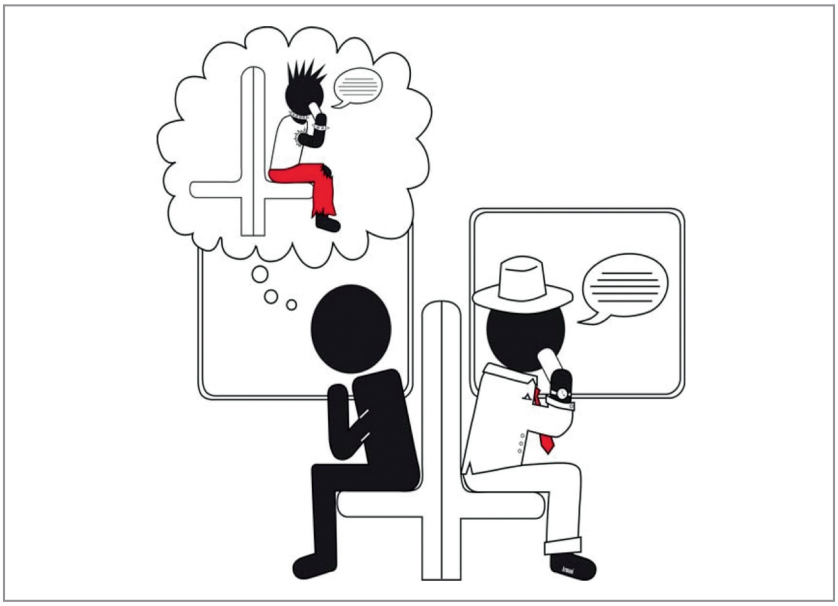
The use and development of web-based health interventions is enabled by the increased use of Internet and smartphones. Over 70% of the United States and Europe citizens use Internet regularly (File & Ryan, 2014; Miniwatts Marketing Group, 2014), and approximately 60% own a smartphone that is used throughout the day (Smith, 2012, 2013). In addition, when people engage in online smartphone activities, most of the time is spent in smartphone applications (TNS NIPO, 2012), which are pieces of software with specific tasks and functionalities that can be downloaded on mobile devices (Cowan et al., 2013; Kratzke & Cox, 2012).

Thousands of smartphone applications in the category "health and lifestyle" have become available in the past few years (Dennison, Morrison, Conway, & Yardley, 2013; Kratzke & Cox, 2012; Sarasohn-Kahn, 2010). Still, not all of these applications are explicitly directed at achieving health behavior change via persuasion, and only few of them are based on theory or health behavior change techniques (Cowan et al., 2013; Dennison et al., 2013; Middelweerd, Mollee, van der Wal, Brug, & te Velde, 2014; Webb et al., 2010; West et al., 2012). In addition, the (potential) efficacy of web-based health interventions has been documented in the field of health persuasion (e.g., Brug et al., 2005; Oenema et al., 2008; Webb et al., 2010). However, to the best of our knowledge, to date only two randomized controlled trials (RCTs) have been conducted to test the efficacy of smartphone application interventions in isolation (Brindal et al., 2013; Glynn et al., 2014). Both studies had a follow-up of only 8 weeks, while only one study showed beneficial effects on a behavioral measure (physical activity).

The development of evidence-based smartphone applications to stimulate health behavior change seems promising (Hebden et al., 2012; Kratzke & Cox, 2012): Besides the potential of reaching many people, it is possible to use multiple communication modes (textual, auditory, video), to engage users in flexible interaction, to contact users throughout the day to improve timing, and, therefore, to apply many types of methods (or behavior change techniques). Persuasive health messages are often applied via the visual mode of communication as written, pictorial or audio-visual messages. Receivers read or watch the information that is provided to them on paper or on screen, for example as a reminder on a package of cigarettes, a printed brochure or a health campaign on television or the Internet. Mostly, they contain only visual elements, such as text and images, or a combination of visual and auditory elements. For instance, in a video campaign, auditory information such as a voice-over or background music is applied in the context of the visual images. Few studies in the domain of health promotion have investigated the auditory mode of communication in isolation, without the possibility that any visual information might overrule the auditory information (e.g., Braverman, 2008; Connell, Goldberg, & Folta, 2001). In the research presented in this thesis, we aim to unravel the processes and effectiveness of auditory forms of health persuasion, that is, when the health information is provided by voice only.

The use of the auditory mode of communication is facilitated by technological advancements. For instance, digital audio formats, among which MP3-technology, are now included in portable music players, smartphones and tablets. Anywhere and anytime, people now have the opportunity to listen to the radio, audiobooks or podcasts (Heye & Lamont, 2010). This illustrates that the potential value and reach of the auditory mode of communication is enormous. In addition, the widespread use of telephones, digital streaming, and (online) radio (Downey, 2002; RAJAR/Ipsos MORI/RSMB, 2014; RAB/GfK, 2013; Webster, 2011) demonstrates that information only communicated through the auditory channel fulfills a need. Thus, the inclusion of the auditory mode in health interventions seems important as it is in line with the use of auditory information to date. Furthermore, attending to auditory information might sometimes be more convenient compared to attending to visually presented information. This can be the case when one is performing simple or automated tasks (car driving, household tasks, sport exercises) or when there is simply no visual information available (for example in a telephone conversation or in other situations in daily life, as illustrated in Figure 1.1). These are situations in which individuals can rely on auditory information instead of visual information. In addition, while the small screen of a smartphone provides relevant limitations for the presentation of text and video, it does not limit the presentation of auditory information.

Figure 1.1 Auditory information processing: An example of a situation in which one is exposed to auditory information only ▼



Moreover, auditory forms of communication are already implemented in health persuasion contexts. This is illustrated by the existence of numerous podcasts or smartphone applications to do physical workouts or mindfulness exercises in which auditory information can be used (Kranz et al., 2013). A coach is then represented by a voice, encouraging recipients and guiding them through the exercises (e.g., Runtastic, 2015), possibly supported by other auditory information such as music or calming sounds. It seems that the auditory mode of communication can be applied as a useful tool in designing and implementing health interventions. In the research addressed in this thesis, it is investigated how an auditory persuasive health message can be applied in the most effective way within a smartphone application intervention to increase fruit and vegetable intake.

Listening instead of reading

Health messages can be provided via different modes of communication. In the context of the present research, recipients will be exposed to persuasive health information that is provided via the auditory mode of communication. This means recipients will listen to information as spoken by a voice. A voice has specific 'acoustical properties of communication' (Street, 1990, p. 122) that can be referred to as vocal nonverbal cues (Scherer, 1980). A voice can be perceived in terms of characteristics of the voice (such as voice pitch) and speech (such as speech rate and non-fluencies; Zuckerman & Driver, 1989). Obviously, speech also includes the subject-matter and more verbal cues (such as the vocabulary and accent used; Allport & Cantril, 1934; Scherer, 1980). Yet, in the current research, the voice and speech characteristics are conceptualized as vocal nonverbal cues that contain both prosodic and paralinguistic aspects (Scherer, 1980; Street, 1990). Prosodic aspects are discretely coded, whereas paralanguage is more continuously coded within speech. Paralanguage includes for example vocal intensity (loudness), fundamental frequency (pitch) and speech rate (Street, 1990). Within this level of paralanguage, prosodic aspects can be applied to give meaning to the information, such as the use of intonation (pitch range) and stress to emphasize an utterance or a word (Street, 1990).

A voice can provide recipients with different sorts of information. First, recipients will perceive a voice without having to make strong inferences about it. That is, the voice can be described in an objective way, for example in terms of decibels, or more subjectively as 'the perceptual representation' of these characteristics (Scherer, 1979, p. 149), for example evaluating a voice as speaking very loud. These two categories have been distinguished by Scherer (1979, 2003) as the 'distal cues' and the 'proximal cues' (in terms of being distant from or close to the recipient), respectively. Second, subjective perceptions of the voice may form the basis of the attribution of individual characteristics to the source of the message. This is associated with stronger inferences,

for example evaluating the source in terms of credibility (Chebat, El Hedhli, Gélinas-Chebat, & Boivin, 2007; Miller, Maruyama, Beaber, & Valone, 1976; Page & Balloun, 1978).

Indeed, it has been long acknowledged that the perceived aspects of the voice and speech may influence person perceptions (e.g., Allport & Cantril, 1934), which one can imagine while comparing a voice breaking from nervousness with a fast-speaking loud voice full of excitement. As such, the attribution of person characteristics based on voice is a relevant topic within contexts of interpersonal communication (Scherer, 1979), stereotyping (Yarmey, 1993; Ko, Judd, & Blair, 2006), and (tele)marketing (Chebat et al., 2007). Perceived characteristics of the voice and speech have not only been associated with inferences on person characteristics (Apple, Streeter, & Krauss, 1979; Scherer, 1979) and perceived source reliability (e.g., Chebat et al., 2007), but also on the speaker's emotions (e.g., Scherer, 2003), and perceived attractiveness (e.g., Zuckerman & Miyake, 1993). In addition, voice characteristics have been found to influence message acceptance and persuasion (Chebat et al., 2007; Gélinas-Chebat, Chebat, & Vaninsky, 1996; Ko et al., 2006; Miller et al., 1976; Pittam, 1990; Smith & Shaffer, 1991).

The above-mentioned role of the voice and the influence on source evaluations and persuasion in auditory communication may partly be related to the notion that an auditory message might provide richer and more complex information on the source, at least compared to a textual message. In addition, an auditory message is presented in a sequential and temporal way as a continuous stream (e.g., Henneman, 1952). This means that the recipient does have limited control over the exposure to the information, as one is more or less forced to listen to the content information that is offered at a specific moment in time. In other words, auditory information passes over time, whereas textually represented information is mostly longer available as it is spatially represented and it 'stands still' (Chambliss & Garner, 1996). In contrast, reading is self-paced (Corston & Colman, 1997); one can decide what parts of the information to focus on, for example on a screen or in a newspaper (exceptions may refer to the processing of textual information that is only available for a short period of time, such as subtitles or a text stream). This may be in line with the finding that textual information is often superior for novel and complex health information (Byrne & Curtis, 2000; Corston & Colman, 1997), but possibly not when the information is simple and well-known.

Furthermore, auditory communication might be perceived as more close and immediate to the recipient, as it is characterized by 'an enhanced sense of social presence' (Chaiken & Eagly, 1983; Jensen, Farnham, Drucker, & Kollock, 2000). Thus, while listening, recipients might experience the information as being addressed in a more personal way, compared to when they would have read the information. This suggests that auditory communication might stimulate self-referent encoding of the information that is provided. While taking into account these aspects of auditory communication (providing complex and rich information, in a continuous stream, that can be perceived

as if it is directly addressed to the recipient), it can be concluded that other aspects than the content persuasive information (peripheral information) may become relatively salient to the recipient. In addition, there are no visual distractions as is the case in audio-visually presented information.

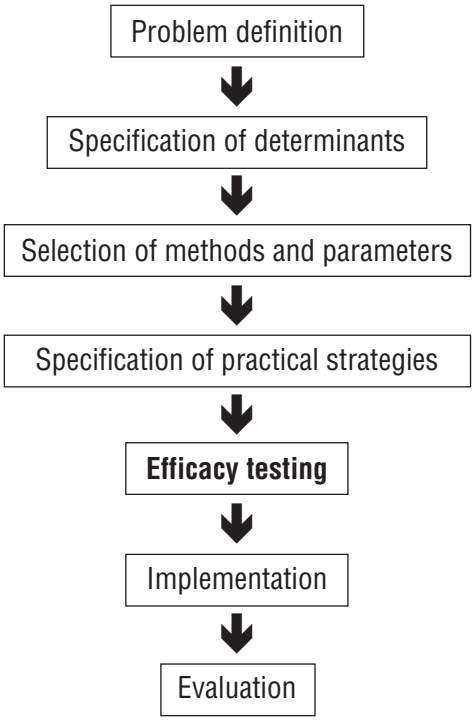
Besides the inferences one can make based on a voice and the salient characteristics in auditory communication, a final difference refers to the way the information can be processed via the central or systematic route of information processing. The information is processed via different senses and subsystems of the working memory, either via the ears and the auditory / verbal system or via the eyes and the visuospatial system (Baddeley, 2000). In turn, other brain regions are activated, for example during listening and reading comprehension processes (Berl et al., 2010). This may differentially influence the processing of auditory and textual health information.

Thus, information presented via the auditory mode of communication consists of different typical aspects that may influence persuasion: The content persuasive information is embedded in and shaped by a voice that varies in ways that are relevant to communication. Therefore, knowledge on general persuasive communication (often derived from studies on textual persuasion) cannot easily or automatically be applied to auditory persuasion, when there is no visual or textual information available.

Intervention development

The aim of the current research was to develop and test an evidence-based smartphone application intervention to increase fruit and vegetable intake among adults, while using the auditory mode of communication. This was done in the framework of intervention development protocols, such as the PATH-model (Buunk & van Vugt, 2008) and Intervention Mapping (Bartholomew, Parcel, & Kok, 1998; Bartholomew, Parcel, Kok, Gottlieb, & Fernández, 2011; Kok, Schaalma, Ruiter, van Empelen, & Brug, 2004). These models provide more insight into the decision-making processes involved prior to the actual implementation of the intervention. Several phases are introduced for evidence-based intervention development, as presented in Figure 1.2.

Figure 1.2 Global presentation of the phases in the (iterative) process of intervention development (based on Bartholomew et al., 2011 and Buunk & van Vugt, 2008) ▼



The first phases of intervention development deal with defining the problem and the specification of determinants of the problem, in order to determine what needs to be changed by means of the intervention. For example, in the current intervention, the desired behavior is specified as an increased fruit and vegetable consumption among Dutch adults up to at least two pieces of fruit and two-hundred grams of vegetables a day, according to recommendations as formulated by the Netherlands Nutrition Centre (2011). In the next phases, the components of the program are designed, based on the theoretical methods that are selected. Furthermore, the parameters (or conditions) under which the theoretical methods are effective are determined, which is essential for the translation of these methods into practical strategies (Bartholomew et al., 1998, 2011; Buunk & van Vugt, 2008; Kok et al., 2004; Kok, Harterink, Vriens, de Zwart, & Hospers, 2006). The practical strategies are designed to be appropriate for the population and the specific channel of the intervention, which is in our case a smartphone application. Ultimately, the smartphone application intervention will be pre-tested (Buunk & van Vugt, 2008) and its efficacy will be assessed. In the final phases of intervention development

protocols, an intervention will be implemented and evaluated (Bartholomew et al., 2011; Buunk & van Vugt, 2008).

The research presented in this thesis can be understood and placed in the middle phases of these protocols, related to the development and design of the intervention components and to the intervention efficacy testing. More specifically, different parameters within which our method can lead to health behavior change will be investigated. This information can help to translate the theoretical methods into effective practical intervention strategies. The main method that is applied throughout this thesis and within the smartphone intervention is persuasive communication by means of argumentation (e.g., Bartholomew et al., 2011). In terms of behavior change techniques (Abraham & Michie, 2008) this can be understood as communicating the link between health and fruit and vegetable consumption, including the expected outcomes of (in)sufficient fruit and vegetable consumption (such as a higher / lower risk on chronic diseases) and additional information to understand this link. The latter can refer to information on the underlying processes (e.g., fruit and vegetables contain vitamins and minerals). In addition, the health message can be framed positively or negatively, or as a combination with both positively and negatively framed arguments. In case of negative framing, it could be argued that besides argumentation as the method or behavior change technique, a fear-appeal is applied as well (Peters, Ruiter, & Kok, 2012; Witte, 1992).

Method parameters. To develop an intervention, it is important to recognize and investigate the parameters (or conditions) under which a theoretical method can be effective, as these parameters play a central role in translating the method into practical intervention strategies (e.g., Bartholomew et al., 1998, 2011). The specific parameters of the intervention refer to the conditions under which the argumentation can be (especially) effective within the auditory mode of health persuasion. This means that we focus on activating facilitating processes that assist the adoption of the communicated health message. For instance, it may be helpful when the source of the persuasive health message is perceived as credible or when recipients perceive the persuasive information as personally relevant. Parameters can exist at different levels; for instance, feedback can be applied in the function of increasing the personal relevance of the information, but it can also be applied as a method in itself (Bartholomew et al., 2011). Furthermore, parameters can refer to aspects within the intervention method, but also to aspects within the recipient. This latter category entails individual difference parameters that may affect the potential efficacy of the health intervention, such as the recipient's initial involvement in the topic of health. Both categories of parameters will be taken into account in the current studies.

Four specific method parameters are studied. First, voice intonation might work as a condition under which auditory health communication can be effective. Intonation is an important prosodic aspect of speech that might influence persuasion (Pittam, 1990),

as it provides information on the emotional meaning and, thereby, on the severity of the expected outcomes (Rodero, 2010). The auditory message might lead to behavior change, but only when the message is spoken with an optimal level of intonation.

Second, the use of background music might work as a condition under which the auditory health information can be effective. For instance, the auditory health message can possibly lead to behavior change, but only when it is accompanied with background music that is preferred by the recipient. On the other hand, background music might distract recipients from listening to the auditory information, as both are communicated via the auditory channel.

Furthermore, the source of the health message is considered a method parameter in the context of the current health intervention. It has been found that it is beneficial for persuasion when the source is perceived as reliable (Petty & Cacioppo, 1984; Pornpitakpan, 2004). The auditory message might lead to health behavior change, but only when it is presented by a reliable source.

Finally, self-referencing will be tested as a method parameter. The message can possibly lead to health behavior change, but only when recipients perceive the information as personally relevant, at least to some extent (Kreuter, Bull, Clark, & Oswald, 1999). Self-referencing can be accomplished in different ways, for example by tailoring the auditory message to individual characteristics (Dijkstra, 2005, 2008; Hawkins, Kreuter, Resnicow, Fishbein, & Dijkstra, 2008).

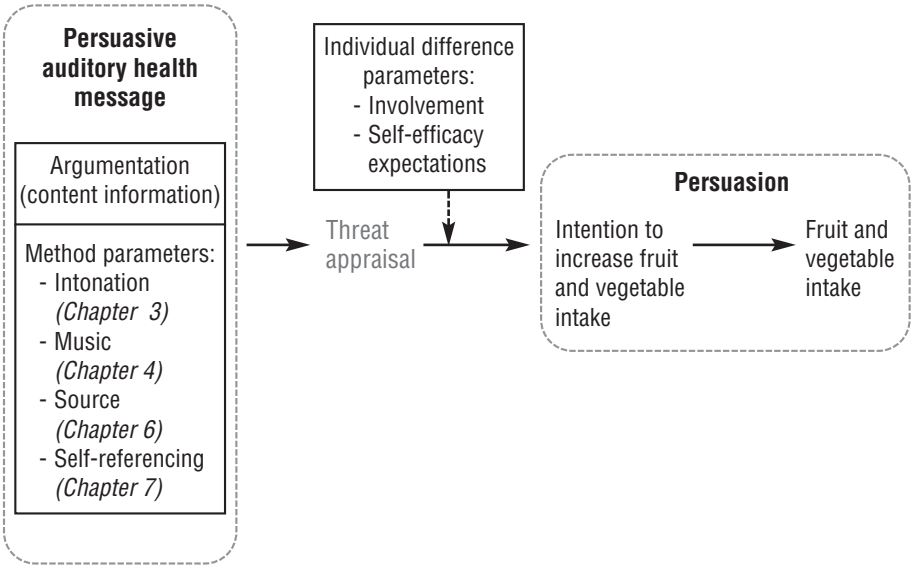
Individual difference parameters. Besides the method parameters, the most important individual difference parameters are the recipient's initial involvement and self-efficacy expectations. Involvement is a measurement of personal relevance, and indicates whether recipients are motivated to elaborate the content information and are willing to invest in changing their health behavior (Johnson & Eagly, 1989; Leippe & Elkin, 1987; Petty, Cacioppo, & Goldman, 1981). In line with this, in the current research involvement is operationalized as the initial value attached to health or as the perceived own health status.

Self-efficacy expectations are beliefs about one's capabilities to adequately perform a behavior, in this case to eat sufficient fruit and vegetables. Perceived self-efficacy may determine whether one will start performing a new behavior, and how much effort will be eventually invested (Bandura, 1986; Kreausukon, Gellert, Lippke, & Schwarzer, 2012). It has been shown to be important in behavior change processes and it is consistently related to fruit and vegetable intake (Brug, Lechner, & de Vries, 1995; Guillaumie, Godin, & Vézina-Im, 2010; Kreausukon et al., 2012; Luszczynska, Tryburcy, & Schwarzer, 2007). In sum, the four method parameters and two individual difference parameters can specify the conditions under which the auditory information intervention is effective and may influence health behavior change. Both are central aspects in the model of auditory persuasion that is described in the following section.

Model of auditory persuasion

The model of auditory persuasion as depicted in Figure 1.3 describes how auditory persuasive health communication can lead to behavior change. More specifically, within the context of our current health intervention, it specifies the relationship between aspects of our auditory health message promoting fruit and vegetable intake, and persuasion. The auditory persuasive message consists of argumentation (the content information) and the specified parameters within which the argumentation can be effective. In addition, persuasion is described as the intention to increase fruit and vegetable intake, which can lead to actual behavior. As is presented in the model, the influence of the auditory health message on persuasion runs through the appraisal of a threat. This may influence whether recipients are motivated to change the behavior in the first place. Furthermore, the threat appraisal is likely to be affected by the relevant individual difference parameters under study. Although it is assumed that level of threat is a central motivational aspect for recipients to engage in behavior change, the role of threat appraisal is not explicitly tested in the current thesis. We were merely interested in the influence of the method parameters and individual difference parameters on persuasion to gain more understanding on the conditions that are necessary to create behavioral change within the auditory mode of communication. The model is described in more detail on the next page.

Figure 1.3 The model of auditory persuasion within the current health intervention ▼



According to the model, the persuasive health message can lead to behavior change via an appraisal of the threat caused by the message. A threat can be defined as 'a danger of harm' (Peters et al., 2012, p.2). The appraisal of threat may consist of estimations on the severity of the harm and on the degree to which one is vulnerable to it (Peters et al., 2012; Witte, 1992). A threat is conceptualized as a cognitive appraisal after being exposed to persuasive health information. Within the current research, the health message on fruit and vegetable intake is always related to relevant outcomes, for example referring to the risk of cancer. The expected negative outcomes are a central component of the threat appraisal. In addition, the positively framed expected outcomes of the behavior induce the awareness that one is missing out on the benefits of sufficient fruit and vegetable intake (Rothman & Salovey, 1997). Furthermore, the information might be perceived as especially threatening when it is communicated via the auditory mode of communication. That is, it includes richer information and it may seem as if the speaker is communicating only and directly to the recipient. As a consequence, the information can be perceived as more personal to the recipient, making it more threatening (Chaiken & Eagly, 1983; Jensen et al., 2000).

In turn, the perceived level of threat partly determines whether or not the recipient is motivated to change the behavior in the advocated direction (Maloney, Lapinski, & Witte, 2011; Witte, 1992). For instance, a sufficiently high perceived threat will be necessary to motivate to change the behavior. However, if recipients experience the threat as too high while being exposed to the information, a defensive reaction might be formed, which may lower persuasion. The individual difference parameters may influence whether a threat appraisal is translated into persuasion. It is expected that defensive responses might take place in recipients who perceive the information as less relevant: Although they know the outcomes are objectively relevant to them, they do not want to make investments and change their health behavior. Moreover, defensive responses may be formed when self-efficacy expectations are low. Recipients with low self-efficacy expectations might perceive a high threat and experience they are 'stuck' in a threatening situation, as they do not see the possibility to change the behavior in the advocated direction. Thus, perceived threat and perceived efficacy interact with each other in their influence on behavior change (Peters et al., 2012; van 't Riet & Ruiter, 2013; Witte, 1992, 1994). This notion is based on the parallel response model (Leventhal, 1971) and the extended parallel process model (Maloney et al., 2011; Witte, 1992, 1994) that aim to describe how people can deal with threat and when defensive or adaptive reactions to threat are formed. In sum, according to our model of auditory persuasion, involvement and self-efficacy expectations influence the extent to which the threat appraisal is translated into the adoption of the advocated behavior.

Thus, the individual difference parameters involvement and self-efficacy expectations are tested as moderators in order to assess for whom the threat might

become too strong to face or for whom the threat appraisal may be translated into a persuasive response in the desired direction. Finally, as presented in the model, our main measures of persuasion are the intention to increase fruit and vegetable intake, and / or self-reported fruit and vegetable intake. In health persuasion, intention is often used as an outcome measure of persuasion after being exposed to a health message. It can be referred to as 'the most immediate and important predictor of a person's behavior' (Sheeran, 2002), also in fruit and vegetable consumption (Pietersma & Dijkstra, 2011). However, it is widely acknowledged that an intention does not always lead to the adoption of the specified health behavior (Webb & Sheeran, 2006). Thus, although intention is not necessarily the basis for behavior change, in our view, it does indicate how recipients experience and process the persuasive information. Measurements of intention are assessed immediately after message exposure, and follow-up behavioral measurements are included from Chapter 5 onwards. Fruit and vegetable intake is assessed with a detailed questionnaire that was validated by showing correlations between the self-reported fruit and vegetable intake and biomarkers such as vitamin C and specific carotenoids (Bogers, van Assema, Kester, Westerterp, & Dagnelie, 2004).

Overview of the present research

In the current thesis, several important aspects of and processes in auditory health persuasion are investigated (see Table 1.1 on page 24 for an overview of all chapters). Chapter 2 reports on two exploratory studies to gain more knowledge on the processes in auditory health persuasion in general. As evaluations of source reliability (referring to perceived trustworthiness, honesty and credibility) are central in persuasion (Briñol & Petty, 2009; Petty & Cacioppo, 1984; Pornpitakpan, 2004), the determinants of perceived source reliability will be central. In the first study, the main question is: "Which (voice and source) characteristics contribute to the image of a reliable source when the only available source information is the voice of the speaker?" The relationships between these perceived characteristics are investigated in a cross-sectional study among a community sample (N = 271) in which respondents listen to a health message communicated by either a male or female voice. In a second study among students (N = 100), we experimentally test the influence of three contextual factors - message framing, matching of the gender of the recipient and speaker, and self-affirmation - on perceived source reliability and intention.

Chapter 3 presents two experiments to answer the following research question: "What is the persuasive influence of voice intonation?" The voice of the speaker is central in auditory health persuasion, and level of intonation can be a relevant parameter in designing an effective intervention that is presented via the auditory mode of communication. More specifically, level of intonation may influence the threat of the persuasive health information, at least for some people. In the first experiment, students

(*N* = 130) listen to a health message that was either recorded with a low, moderate, or high level of intonation. In collaboration with a professional recording studio, the actress was instructed to alter the intonation while keeping the other voice characteristics as constant as possible to enhance the extent to which the recording could be perceived as natural. In the second experiment (*N* = 143), a self-affirmation procedure is added (Epton & Harris, 2008; Harris & Napper, 2005; McQueen & Klein, 2006) to explore whether defensiveness can possibly explain the effects of intonation. In both studies, perceived own health is tested as an individual difference parameter. Persuasion is operationalized as the intention to increase fruit and vegetable intake.

Chapter 4 aims to answer the question: "What is the effect of background music in auditory health persuasion?" In this chapter, background music is conceptualized as the second parameter within which auditory forms of health persuasion can be effective in supporting health behavior change. Process measures are included to investigate how the effect of background music can be explained, and self-reported health value is tested as an individual difference parameter. Students (*N* = 146) listen to a health message with either background music they did or did not identify with, or background music which is known to induce a positive mood. The control condition comprises a health message without any background music. With this experimental design it is possible to investigate how background music affects persuasion, and whether this is related to processes of identification, mood, or distraction. Again, persuasion is operationalized as the intention to increase fruit and vegetable intake.

Chapter 5 presents an experimental study to answer the question: "How do the opportunities to self-regulate during the processing of auditory and textual persuasive health information affect the relationship between intention and behavior?" While reading, recipients have the possibility to strategically use eye-movements and attention-allocation, while during listening one has the possibility to form biased perceptions of the source that is presented by the voice. These possibilities might be applied in the function of defensive self-regulation to cope with threatening information. Students (*N* = 128) are exposed to a health message, either presented as a text, as an audio-fragment, or as a text stream in which the information is presented visually. This means that recipients are only exposed to one part of a sentence at a time; the subsequent part appears while the previous one automatically disappears again. It is reasoned that the opportunities for self-regulation do not exist when one is exposed to the text stream message, compared to the textual or auditory message. While using these three communication modes, the effect of the availability of self-regulation possibilities on the intention-behavior relationship is investigated. Besides an immediate measurement of intention, fruit and vegetable intake is measured two weeks after message exposure.

Chapter 6 focuses on the question: "What is the effect of providing source information within the auditory mode of persuasion?" In an experimental study, the effects

of auditory source introductions will be tested, ranging from an expert in the field to a source that is similar to the target group. The inclusion of source information can be considered a relevant parameter in designing an effective health intervention applied via the auditory mode: The perception of the source may be more accessible in auditory information as the (close and self-referring) voice is heard from the first to the last word of the message. This study may provide relevant practical insights with regard to the inclusion of source introductions in an auditory health intervention. Students (N = 147) listen to a health message in which the speaker introduces herself either as a physician, a nutritional scientist, an employee of the Dutch nutrition center, or a fellow student. The control condition is a health message without a source introduction. Self-reported health value is tested as an individual difference parameter, and the dependent variable is self-reported fruit and vegetable intake as assessed two weeks after message exposure.

Chapter 7 addresses the following research question: "What are the effects of three different tailoring ingredients on persuasion in auditory health messages?" Self-referencing is conceptualized as another parameter within which auditory forms of health persuasion can be effective. This is tested by applying tailoring ingredients (such as feedback on the own fruit and vegetable intake or personalization cues) to make the information more personally relevant to the recipient (Dijkstra, 2008; Kreuter et al., 1999a). Indeed, computer-tailoring is a relevant and feasible possibility in web-based or smartphone interventions. Besides testing whether it is useful to include one of the tailoring ingredients, the influence of self-efficacy expectations as an individual difference parameter is studied. Students (N = 112) listen to a health message that either includes the own first name (personalization), feedback on the own fruit and vegetable intake, or that is adapted to the students' most important value (i.e., enjoying life versus health). The control condition comprises the general health message without any tailoring ingredients included. The main dependent variable is again self-reported fruit and vegetable intake as assessed two weeks after being exposed to the health message.

Partly based on the findings of the previous empirical chapters, a smartphone application intervention is created, that is presented in Chapter 8. The following research question is addressed here: "What are the effects of a computer-tailored smartphone application intervention as delivered via the auditory or the textual communication mode on fruit and vegetable intake?" This chapter provides relevant information concerning the effects of auditory communication in health interventions applied via a smartphone application. In a randomized controlled trial among Dutch adults (N = 146), the efficacy of the tailored interventions as delivered via either the auditory or the textual communication mode will be tested. A control condition is included in which respondents are not exposed to any form of tailored health information. In addition, it is tested for whom (one of) the interventions can potentially lead to health behavior change; perceived own health status is tested as an individual difference variable. Health literacy is tested

as an individual difference as well, as this study is conducted in a more heterogeneous sample in which health literacy may possibly vary in a meaningful way. Self-reported fruit and vegetable intake at six-month follow-up is the main dependent variable.

Finally, Chapter 9 includes a summary, an attempt to integrate the findings of the different studies, and a reflection on the limitations of the presented research . Furthermore, we formulate recommendations with regard to future research and practice on auditory forms of health persuasion[1].

[1] Please note that all chapters have been written to be read independently from each other. In addition, I mostly use the term "we" instead of "I" throughout this dissertation as all studies have been carried out in collaboration with my promotor Arie Dijkstra and with the co-authors Annemarie Bartels (Chapter 5), Andrea Rozema (Chapter 7), and Anke Oenema (Chapter 8).

Table 1.1 Overview of the empirical chapters ▼

	Chapter 2	Chapter 3	Chapter 4	Chapter 5	Chapter 6	Chapter 7	Chapter 8
Design	Online survey (study 1), Experiment (study 2)	Experiment (studies 1 & 2)	Experiment	Experiment	Experiment	Online experiment	Randomized field experiment
Factors	Message framing, Gender, Self-affirmation (study 2)	*Parameter:* Level of intonation	*Parameter:* Background music	Communication mode	*Parameter:* Source introduction	*Parameter:* Tailoring ingredients	Communication mode
N	271, 100	130, 143	146	128	147	112	146
Immediate post-test	Perceived source reliability (study 1), Intention (study 2)	Intention	Intention	Intention	Intention	Intention	–
Follow-up (fruit and vegetable intake)	–	–	–	Yes (2 weeks)	Yes (2 weeks)	Yes (2 weeks)	Yes (6 months)

Chapter 2

Source reliability in auditory health persuasion: its antecedents and consequences

Abstract

Persuasive health messages can be presented through an auditory channel, thereby enhancing the salience of the source, making it fundamentally different from written or pictorial information. We focused on the determinants of perceived source reliability in auditory health persuasion by investigating it from two distinct angles. Respondents listened to persuasive health information while no visual cues were available. Study 1 (N = 271) showed that both inferences on the voice (pleasantness) and person (e.g., similarity) significantly predicted perceived source reliability. In addition, the person characteristics mediated the relationship between perceived voice characteristics and source reliability. In a second (experimental) study (N = 100), three contextual factors (message framing, level of processing, gender matching) affected perceived reliability independently. Furthermore, perceived reliability mediated the effect of message framing on persuasion. In sum, the evaluation on source reliability in auditory persuasion seems to be affected by several factors that are partly unique to auditory communication. These exploratory studies may inspire further research on auditory (health) persuasion.

▶ Chapter 2 is based on Elbert, S.P., & Dijkstra, A. (in press). Source reliability in auditory health persuasion: its antecedents and consequences. *Journal of Applied Biobehavioral Research*

Source reliability in auditory health persuasion: its antecedents and consequences

Health information is mostly communicated through text and images and might be presented as a reminder on a package of cigarettes or as a health message on television. However, health information can also be presented through an auditory channel. A classic form of auditory communication is the radio, which is available all over the world. Research shows that 84.8% of the American people older than 12 years listen to the radio on a daily basis (Downey, 2002) and similar percentages are found in the United Kingdom (RAJAR/Ipsos MORI/RSMB, 2014) and the Netherlands (RAB/GfK, 2013). In addition, the use of online radio is on the rise (Webster, 2011). Moreover, new technological developments facilitate the use of auditory channels. In particular, MP3 is a technological advancement broadly disseminated in modern society and used by millions of people. It is now included in easy portable MP3-players, smartphones, and tablets, which makes the potential value and reach of MP3 as a channel of auditory information enormous.

The present studies are on auditory health persuasion in which recipients listen to a voice that provides information concerning healthy behaviors. Although the content information - arguments and recommendations - may be similar to those used in visual forms of persuasion (e.g., written or pictorial), the nonverbal cues differ essentially as no visual cues are available in auditory persuasion (Chaiken & Eagly, 1983). Auditory information contains nothing to see, that is to say neither fonts, colors, movements nor images. Therefore, the perception of voice and speech characteristics, such as voice pitch and speech rate, becomes relatively salient. These characteristics are an important part of nonverbal communication and may provide the recipient with additional information regarding the speaker's emotions and personality traits (Brown & Bradshaw, 1985). In contexts in which no visual cues are available, (e.g., a telephone conversation) voice can play a major role in for example impression formation and stereotyping (Brooke & Ng, 1986; Ko, Judd, & Blair, 2006). Thus, when no other information regarding the source of the message is available, the source is perceived mainly based on the voice. Therefore, voice and speech characteristics are important aspects in the study of auditory persuasion.

To gain insight into the processes involved in auditory persuasion, a closer look at models of persuasion is useful. The elaboration likelihood model (ELM: Petty & Briñol, 2012; Petty & Cacioppo, 1986) distinguishes between two distinct routes to persuasion. The central route refers to the processing of issue-relevant information, which is likely to be similar to the information presented in other communication modes. On the other

hand, the peripheral route refers to the processing of peripheral, nonlinguistic cues, including prosody and paralinguistic aspects in auditory persuasion (Street, 1990). Other aspects can also work as peripheral cues, such as message framing, the number of arguments and the order in which they are presented (Maheswaran & Meyers-Levy, 1990; Petty & Cacioppo, 1984), as present in both visual and auditory forms of persuasion.

In addition, the heuristic systematic model (HSM: Chaiken, Liberman, & Eagly, 1989) provides further insight into how available peripheral cues might influence persuasion: Heuristics are used to formulate quick, efficient judgments about the persuasive message. In auditory persuasion, this may concern the processing of voice and speaker characteristics (e.g., "The speaker sounds very nice, so I trust him") as well as contextual aspects of the content (e.g., "It sounds familiar, so it must be true"). Heuristic processing may affect persuasion by its own, but it can also influence the systematic processing of the information (Chaiken & Maheswaran, 1994). For example, listening to health information provided by a highly credible source may positively bias systematic information processing. Especially in audio- or videotaped (vs. written) messages, voice aspects are salient and might in turn exert a relatively large impact on persuasion (Chaiken & Eagly, 1983).

Thus, different aspects of the voice can be characterized as peripheral cues that activate heuristics (Gélinas-Chebat, Chebat, & Vaninsky, 1996). These aspects and how they are perceived can affect source perceptions, for example, slow talking speakers are judged as less credible and trustworthy (Apple, Streeter, & Krauss, 1979; Chebat, El Hedhli, Gélinas-Chebat, & Boivin, 2007). In persuasion, evaluations of source credibility are central and specify whether the message can be believed and considered as valid (Petty & Cacioppo, 1984; Pornpitakpan, 2004). Person characteristics related to this are perceived trustworthiness and honesty (Pornpitakpan, 2004), which are associated with perceived message accuracy, a potential determinant of persuasion (Priester & Petty, 1995). In the current studies, perceived credibility, perceived trustworthiness and perceived honesty of the source are conceptualized as *perceived source reliability,* which can be related to persuasion as well.

In sum, two studies addressed the determinants and consequences of source reliability in persuasion by exposing respondents to auditory health information communicated by a voice, either male or female. The concept of perceived source reliability is investigated from distinct angles: In Study 1, the *perceptions* of voice characteristics and person characteristics (source evaluations) are tested as predictors of perceived source reliability. In Study 2, three contextual message aspects - message framing, level of processing, and source gender - were studied experimentally with perceived source reliability and persuasion (intention to eat more fruit and vegetables) as dependent variables.

Study 1

In the first study, it is assessed how one kind of perception – the reliability of the source – is related to other perceptions on characteristics of the voice and the person. The reflection construction model (Jussim, 1991) was applied to structure the different types of perceptions; the model describes the relationships between social perceptions and social reality. While the background information is (semi-)objectively based on no or simple inferences, in the construction process this information is interpreted using mental schemas, assumptions, heuristics, inferences, etc. In the present context of auditory persuasion, the background information refers to the perceived voice characteristics (e.g., speech rate), while the constructions refer to more advanced interpretations about the characteristics of the source and it's behavior (communicating a health message). After listening to one of the two speech recordings (either a male or female voice), these judgments are assessed and it is explored how both the voice perceptions and source evaluations contribute to the perceived reliability of the source.

The voice characteristics under study (the background information) are perceived speech rate, voice intensity, voice pitch and intonation. These characteristics are the most relevant dimensions of voice cues (see also Apple et al., 1979; Gélinas-Chebat et al., 1996). To evaluate these cues, few assumptions have to be made. In this study, the perceived pleasantness of the voice is assessed as background information, as it is also formed without many inferences and it is a primary direct evaluation of the voice (instead of the person). It can be conceptualized as an affective component of an attitude ("I like oranges"). In our theorizing, perceptions of source characteristics are formed on the basis of the background information that is available. In the context of persuasive communication and health education, relevant person characteristics related to source reliability are perceived similarity and persuasive intent (being faced with the communicator's explicit "desire to influence"; Petty & Cacioppo, 1984; Pornpitakpan, 2004; Reinhard, Messner, & Sporer, 2006). Related to the latter is whether the speech is perceived as exaggerated. In addition, the vocal expression of enthusiasm is found to be relevant in judging others (Wexley, Fugita, & Malone, 1975). Conclusions on similarity, persuasive intent, exaggerated speech, and enthusiastic speech demand higher levels of inference: They require more imagination and are based on ideas and perceptions regarding the (speech of the) source and his or her psychological state and motivation. These aspects are generally based on the available background information (the perceived voice characteristics). In addition, these aspects might also contribute to perceived source reliability.

In sum, we will investigate how perceived voice characteristics (e.g., speech rate) and evaluations on the source (e.g., similarity) are related to perceived source reliability when the only source information is the voice heard. It is expected that perceptions of

similarity and enthusiasm will be positively related to the perception of source reliability, whereas perceived persuasive intent and exaggeration might negatively affect perceived source reliability. In addition, it is reasoned that the perceived voice characteristics may inform people regarding person characteristics. For instance, perceptions of intonation may lie at the basis of perceptions of persuasive intent, exaggerated and enthusiastic speech. In turn, perceptions of person characteristics may influence perceived source reliability (Gélinas-Chebat et al., 1996). Thus, voice characteristics might be related to perceived source reliability, but this relation is expected to be mediated by person characteristics. Correlations across the ratings of individual listeners are computed, the perceived voice and person characteristics are regressed on perceived source reliability, and mediation analyses are performed.

Method

Recruitment and design. The present study was an online survey. To recruit respondents, requests were sent to Dutch Internet websites (such as a local newspaper website and websites regarding health, such as Health Magazine) to publish the link to the survey. Participants were randomly assigned to a health message advocating fruit and vegetable consumption spoken by a male or female voice (between-subjects design).

Procedure. Respondents were introduced to the research by a screen with an informed consent form, stating the confidentiality and the duration of the research (<15 minutes). First, respondents were asked to answer socio-demographic questions. Next, they were exposed to a screen with an audio-player, with the possibility to start the recording themselves and to adjust the level of the volume of the health message to their individually preferred level. After listening to the health message, the respondents were asked to answer questions regarding the voice and source.

The health message. Two professional actors with a voice characterized as gender congruent (a woman with a feminine, higher pitched voice and a man with a masculine and lower pitched voice) without idiosyncratic, specific cultural or habitual elements (such as an accent) were selected by the authors in collaboration with a professional recording studio. The message (237 words; see Appendix 1a and 2, QR-code 1) was recorded in the studio by giving the actors instructions to read it like a professional newsreader. Both versions were almost identical in terms of length (105 seconds (male voice); 107 seconds (female voice)). The outcomes presented in the message are based on Dijkstra, Rothman, & Pietersma (2011). The message advocated fruit and vegetable consumption in a positive frame; to gain good health.[1]

[1] The design of the study included a negatively framed message as well, spoken by the same male and female voice. However, these conditions were not of primary interest to us in the context of the current study, and for the sake of clarity we therefore excluded these conditions from the dataset.

It presented two major positive physical outcomes of sufficient fruit and vegetable consumption: a decreased risk for cancer and for heart diseases. In addition, sufficient consumption was said to lead to looking more healthily, to improve physical stamina and concentration on mental tasks. Low blood pressure and low levels of cholesterol were presented as two intermediary positive physical states related to these consequences. Furthermore, the effects were told to be related to increased intake of vitamin C and E.

Measures. Socio-demographic variables assessed were gender, age and highest level of completed education, coded as low, medium or high. After exposure to the auditory message, participants got general instructions to answer the questions on source perceptions. Based on O'Sullivan, Ekman, Friesen, & Scherer (1985), seven-point scales were used to rate source evaluations. The items on source honesty and trustworthiness ranged from 'not at all honest / trustworthy' to 'very honest / trustworthy'. In addition, an item was added on source credibility, ranging from 'not at all credible' to 'very credible'. The average of these three ratings constituted the measurement of perceived source reliability; α = .82, *M* = 5.39, *SD* = .98. Voice characteristics assessed were perceived speech rate, voice intensity, voice pitch, intonation and the experience of a pleasant voice. Person characteristics assessed were similarity and intentionality ("To what extent do you think the speaker… is similar to you / was trying to persuade you?") and the extent to which the speech was perceived as enthusiastic and as exaggerated ("The speaker communicated the message in an enthusiastic / exaggerated way"). Participants could respond to these 1-item measures on seven-point scales with item-specific endpoints, for example ranging from 'very slow' to 'very quick', from 'not at all similar' to 'very similar', or from 'not at all enthusiastic' to 'very enthusiastic'. Finally, some other questionnaires not pertinent to the current study were administered.

Results and discussion

Participant characteristics. The total sample consisted of 271 participants (197 women, 73%), varying in age from 18 to 73 years (*M* = 47.08, *SD* = 13.72). Most participants had an intermediate level of education (*n* = 114 (42%); low education *n* = 85 (31%) and high education *n* = 72 (27%)). Because of the wide range of both age and level of education and the possibility that these variables are related to the reception of health messages, they were added as covariates in the below regression analyses.

Manipulation checks. It was analyzed whether the voices were actually perceived as male (n = 139) or female (n = 132). Voice pitch is the most important cue to differentiate between male and female voices (Ko et al., 2006), measured by fundamental frequency in Hertz (Hz)[2]. The female voice was perceived as significantly higher in pitch compared to the male voice; $F(1, 269) = 47.29$, $p < .001$, $\eta_p^2 = .15$ (M = 4.11, SD = .73 vs. M = 3.45, SD = .86). For the female voice, this differed significantly from the midpoint of four ($p < .001$); for the male voice this difference was marginally significant ($p = .075$). In addition, it is analyzed whether speech rate and intonation were perceived as average in the whole sample. Indeed, the mean scores for perceived speed and intonation were around the midpoint of four; M = 3.79 (SD = .76) and M = 4.27 (SD = 1.31), respectively, both means differing significantly from the midpoint of four ($p < .01$). Relatively high scores on perceived pleasantness were found for both the male and female voice, not differing significantly ($p = .36$) from each other: M = 5.19 (SD = 1.50) and M = 5.35 (SD = 1.24), respectively, both differing significantly from the midpoint of four ($ps < .001$).

Correlational analyses. Table 2.1 shows the correlations between the variables under study; the perceived voice characteristics, perceived person characteristics, and perceived source reliability. Source reliability was significantly related to perceived speech rate, intonation and the experience of a pleasant voice (correlations r = .13, r = .35, r = .58, respectively). In addition, source reliability was significantly related to the person characteristics similarity, the perception of enthusiastic and exaggerated speech (correlations r = .41, r = .49, r = -.32, respectively).

[2] The male voice averaged 117 Hz and the female voice 174 Hz, as measured with the software program "Praat" (Boersma, 2004), using a .01 seconds interval of measurement. All parameters were set to the given recommendations, including pitch range between 75 Hz and 600 Hz.

Table 2.1 Correlations between perceived source reliability and the voice and person characteristics ▼

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Reliability	–									
2. Speech rate	.13*	–								
3. Intensity	.10	.25**	–							
4. Voice pitch	.02	.08	.24**	–						
5. Intonation	.35**	.15*	.22**	.18**	–					
6. Pleasantness	.58**	.20**	.11	.04	.40**	–				
7. Similarity	.41**	.18**	.08	.11	.28**	.37**	–			
8. Intentionality	.10	.00	.19**	.06	.12	-.02	.10	–		
9. Enthusiasm	.49**	.24**	.17**	.18**	.53**	.48**	.26**	.22**	–	
10. Exaggeration	-.32**	-.28**	.01	.06	-.21**	-.30**	-.20**	.12*	-.15*	–

Note. **Correlations are significant at the .01 level (two-tailed), *correlations are significant at the .05 level (two-tailed).

Regression analyses. To test the multivariate relations of perceived voice and person characteristics with perceived source reliability, a regression analysis was conducted. Besides age and level of education, gender matching was included as a covariate . These control variables did not contribute significantly to the explained variance in perceived source reliability (R^2 = .003). Subsequently, all voice and person characteristics were simultaneously included for exploratory purposes; together, these variables added 46.8% to the explained variance in perceived source reliability; $F_{change}(9, 258) = 25.35$, $p < .001$. The perception of a pleasant voice predicted source reliability significantly (b = .252, SE = .041; t = 6.19, $p < .001$). Perceived speech rate, intensity, voice pitch and intonation were not significantly related to source reliability in this multivariate model.

Regarding the person characteristics, perceived similarity (b = .114, SE = .028; t = 4.12, p < .001), perceiving the speech as enthusiastic (b = .193, SE = .043; t = 4.53, p < .001) and exaggerated (b = -.096, SE = .030, t = - 3.24, p < .01) were significant predictors of source reliability (in the expected directions). Perceived intentionality did not significantly contribute.

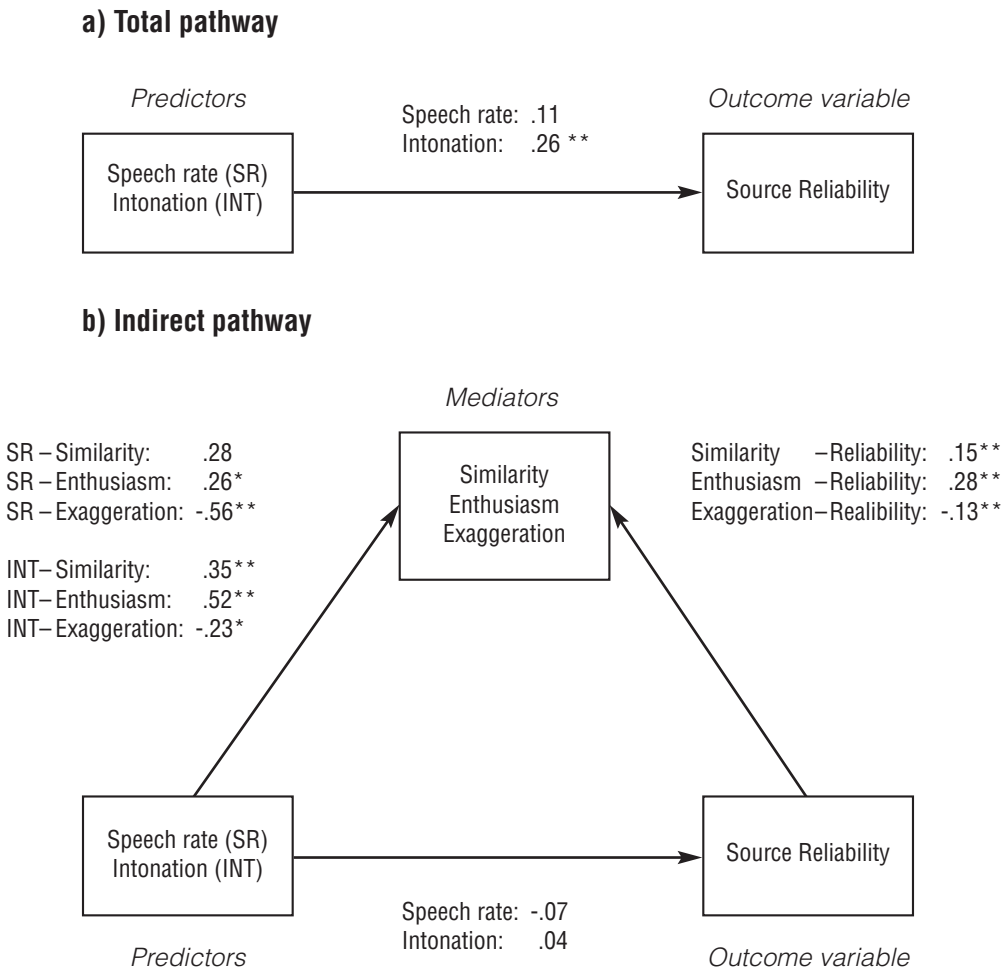
While the perceptions of the voice cues (e.g., speech rate) did not significantly predict perceived source reliability, the perception of a pleasant voice did, as well as the perceived person characteristics similarity, enthusiasm, and exaggeration. Similarity predicted reliability beyond the gender matching variable that might be interpreted as an objective parameter of similarity. It seems that gender only was not a relevant aspect of similarity in auditory persuasion, at least not in this broad naturalistic sample. These data partly support the hypothesis that perceptions of voice and person characteristics help people to construct a mental image of the source, especially regarding perceived source reliability.

Mediation analyses. It was predicted that person characteristics would mediate the relationship between voice characteristics and perceived source reliability. A multiple mediation analysis was conducted to test a model consisting of several independent variables and several mediators simultaneously (Hayes & Preacher, 2014). Bootstrapping was applied (using 5000 resamples) to estimate the indirect effects and to assess their significance via 95% confidence intervals (CI). The model included speech rate and intonation as independent variables, perceived source reliability as dependent variable and the person characteristics similarity, enthusiasm and exaggerated speech as mediating variables. The three control variables were included as covariates. The overall model was significant; adjusted R^2 = .37, $F(8, 262) = 20.71$, p < .001. The indirect effects and confidence intervals showed that all mediations were significant (as the CI did not include zero; Hayes & Preacher, 2014; Preacher & Hayes, 2008), except for perceived similarity as mediating variable between speech rate and source reliability (see Table 2.2). Coefficients for relations among the variables are displayed in Figure 2.1. The results are in line with the expectation that higher inference evaluations give a meaningful interpretation to the voice characteristics. In turn, these interpretations can serve as possible indicators of source reliability.

Table 2.2 Results for tests of indirect effects in mediational model ▼

		Bootstrapping (95% *CIs*)		
	Point estimate	***SE***	**Lower**	**Upper**
Indirect effects through similarity				
Speech rate	0.04	0.02	0.00	0.09
Intonation	0.05	0.02	0.02	0.09
Indirect effects through enthusiasm				
Speech rate	0.07	0.03	0.02	0.14
Intonation	0.15	0.03	0.09	0.21
Indirect effects through exaggeration				
Speech rate	0.07	0.03	0.02	0.13
Intonation	0.03	0.02	0.01	0.06

Figure 2.1 Mediation of the relationship between voice characteristics and perceived source reliability through person characteristics (perceived similarity, enthusiasm, and exaggerated speech) ▼



Note. Panel a shows the total effect of speech rate and intonation on perceived source reliability. Panel b shows the indirect effects and the direct effect when the mediators are taken into account. The three control variables were almost never significantly related to the outcome variable. However, they were always taken into account in this multiple mediation model because of the theoretical relevance. *corresponds to a p-value smaller than .01, **to a p-value smaller than .0001. Specific indirect effects are reported in Table 2.2.

In addition, based on the earlier conducted regression analyses, perceived pleasantness of the voice was explored as a mediator between a) the voice characteristics speech rate and intonation and perceived source reliability and between b) the person characteristics similarity, enthusiasm and exaggeration and perceived source reliability.

Results showed that perceived pleasantness mediated the relation between both voice characteristics and perceived reliability; the overall model was significant (adjusted R^2 = .35, $F(6, 264) = 24.83$, $p < .001$) as well as the coefficients for the indirect effects through perceived pleasantness for speech rate (b = 0.11, SE = 0.04, *95% CI* 0.04; 0.18) and intonation (b = 0.16, SE = 0.03, *95% CI* 0.10; 0.23). Thus, perceived speech rate and intonation inform the recipient regarding pleasantness, which in turn functions as an indicator for increased source reliability.

Next, perceived pleasantness was tested as a mediator between the person characteristics and perceived reliability. The overall model was again significant (adjusted R^2 = .45, $F(7, 263) = 32.26$, $p < .001$). The coefficients for the indirect effects were as follows: Similarity b = 0.04, SE = 0.01, *95% CI* 0.02; 0.07; enthusiasm, b = 0.10, SE = 0.02, *95% CI* 0.06; 0.15 and exaggeration, b = -0.04, SE = 0.01, *95% CI* -0.07; -0.02, showing that mediations are present. This confirms the notion that perceived voice pleasantness is an aspect of the voice different from the other four voice characteristics. Theoretically, voice characteristics are based on objective voice parameters, whereas a perceived pleasant voice may be based on both voice- and person characteristics.

Study 2

The first study suggested that recipients' ideas about source reliability are based on perceptions of both voice and person characteristics. Yet, to cover a broad perspective on auditory persuasion, Study 2 was designed to experimentally investigate contextual factors that also may influence source reliability: message framing, mode of processing (peripheral or central) and gender matching.

The positive or negative framing of a message is one way to vary "what is said", and can be interpreted as a peripheral cue that activates a heuristic: The message may "just sound negative or positive" apart from the actual content (Maheswaran & Meyers-Levy, 1990). Several studies have shown that when peripheral aspects of framing are processed, positive framing was more persuasive than negative framing (e.g., Maheswaran & Meyers-Levy, 1990). In addition, based on the Prospect theory (Tversky & Kahneman, 1981), a positive frame is expected to be more effective in stimulating prevention behaviors such as fruit and vegetable intake (as advocated here) compared to a negative frame (Rothman & Salovey, 1997). That is, a positive frame activates the notion of "play it safe", which is congruent with prevention behaviors on approaching possible positive outcomes (in contrast, a negative frame activates the notion of "nothing

to lose", and therefore would more strongly stimulate detection behaviors; approaching possible negative outcomes). Thus, in auditory persuasion, the positive frame may be relevant as it is a peripheral cue with positive valence, and it is congruent with a message on fruit and vegetable consumption (Broemer, 2004). The congruence within the positively framed message condition is expected to transfer to the reliability of the source, whereas this fit is lacking in the negatively framed message condition. Although for prevention behavior messages relatively small differences between positive and negative message framing persuasiveness were reported in a meta-analysis (O'Keefe & Jensen, 2007), here it is expected that a positive frame leads to higher perceived source reliability.

In addition, the voice and source are disproportionally salient in auditory persuasion (Chaiken & Eagly, 1983); both are integrated in the speech itself, which means that the peripheral cues are received simultaneously with the content information. In auditory persuasion, it may be that the voice as a peripheral cue captures a lot of processing capacity, thereby leading to relatively less central processing of the content information. Thus, assuming that the source is evaluated especially on the basis of the voice, the source evaluation may change when recipients are enticed to process the auditory message more centrally. Based on the vocal attractiveness stereotype (Zuckerman & Driver, 1989) and the mediations in Study 1, we can reason that perceived source reliability may be judged positively given a voice experienced as pleasant. In Study 1, the used voices were rated relatively high on perceived pleasantness. Therefore, it can be expected that perceived source reliability is lowered when participants' processing of the auditory message moves away from the pleasant voice (that is related to higher reliability) towards more central processing. To assess these possible processes, we will apply a self-affirmation procedure that is known to induce central processing of persuasive information (Correll, Spencer, & Zanna, 2004). Self-affirmation may thus lead to lower perceived source reliability in auditory persuasion. This effect might be most explicit after listening to the positively framed message when the source is perceived as reliable (Study 1), as the induction of central processing moves the respondent's attention away from the positive peripheral cue; away from the voice, but in this case also away from the positive valence of the message (Maheswaran & Meyers-Levy, 1990). Earlier studies also showed that self-affirmation led to more negative thoughts and less positive thoughts, specifically when the message was positively framed (Zhao & Nan, 2010).

Matching the gender of the source to the respondent's gender will be added as an additional factor that can affect persuasion. Besides the respondent's gender, knowing the gender of the source may influence source evaluations, which is mainly investigated in radio advertising contexts or sales research (Dwyer, Richard, & Shepherd, 1998; Whipple & McManamon, 2002). A gender match, which is a basic form of similarity, might lead to higher perceived source reliability and more persuasion (Dwyer et al.,

1998). However, the communicator's gender in interaction with the gender of the receiver did not affect the relationship between voice characteristics and perceived source credibility in a telemarketing context (Chebat et al., 2007). Although Study 1 showed no effect of gender matching on perceived source reliability in a health context as well, it will be examined among university students in Study 2.

Thus, the starting point is the three-way interaction between message framing, self-affirmation and gender matching. It is expected that a gender match will only lead to higher perceived source reliability and more subsequent persuasion when the congruency effect occurs, that is, when the message is framed positively. In addition, self-affirmation will only lower reliability and persuasion in case of a gender match in positive framing. The dependent variables are perceived source reliability and intention to eat more fruit and vegetables (as an indicator of persuasion).

Method

Design. The study applied a 2 (message frame: positive, negative) × 2 (self-affirmation, no self-affirmation) × 2 (respondent/speaker gender matching: match, mismatch) between-participants factorial design. The experiment was conducted in the laboratory of the Faculty of Behavioral and Social Sciences among students from the University of Groningen. Participants received either partial course credit or were given a monetary compensation.

Procedure. On arrival in the laboratory, participants were welcomed and allocated to one of four individual cubicles. Assessments and manipulations were all presented on a computer. The participants were randomly assigned to one of the experimental conditions and they were told that the study (<30 minutes) included an auditory message and questions on personal values. After a first set of questions, the self-affirmation procedure was applied. Then, auditory instructions on adapting the volume of the headphone were given and respondents could adjust the volume to their individually preferred level. Then, the respondents listened to one of the health messages, either positively or negatively framed and either spoken by a male or female voice (the same voices as in Study 1 are used). The positive framing message as in Study 1 was used and a negative framing message (242 words; see Appendix 1b and 2, QR-code 2) was designed to differ only in the framing of the arguments; to prevent bad health instead of gaining good health (Dijkstra et al., 2011; Rothman & Salovey, 1997). For example, insufficient consumption was now said to decrease physical stamina. Next, several questions were asked representing the manipulation checks and dependent variables. Finally, participants were debriefed and dismissed.

Materials and measures. The first set of questions included two items on pre-test intention to consume more fruit and vegetables in the next year: "I am planning to…within one year" and "How likely is it that you…within one year?" Both items could

be answered on five-point scales ranging from 'absolutely not' to 'absolutely' and were averaged to create a composite measure (r = .68, p < .001, M = 3.29, SD = .90).

The self-affirmation procedure was based on Allport, Vernon & Lindzey's (1960) 'study of values' (e.g., Correll et al., 2004; McQueen & Klein, 2006). Participants selected their most and least valued domain from the following list: 'theoretical', 'economic', 'aesthetic', 'social', 'political', and 'religious'. In the self-affirmation condition ten dichotomous questions were asked of which eight included one answering option concerning their most important value. Thus, respondents were mostly given the opportunity to choose the option reflecting their most important value, which is thought to comprise the self-affirmation. In the no-self-affirmation condition the ten dichotomous questions mainly contained options concerning their least important value.

Perceived source reliability was measured as in Study 1 (α = .78, M = 5.62, SD = .74). The participant's intention to increase fruit and vegetable intake was assessed within three different time-frames (one month, six months and five years, respectively). To lower the probability of participants answering strategically (remembering their pre-test score), these items could be answered on seven-point scales ranging from 'absolutely not' to 'absolutely' and were averaged to create a composite measure (α = .94, M = 5.04, SD = 1.32). Two questions addressed the extent to which the message contained positively and negatively framed arguments to consume more fruit and vegetables, respectively. These questions could be answered on a nine-point scale ranging from 'no positively / negatively framed arguments' to 'a lot of positively / negatively framed arguments'. Finally, some other questions not pertinent to the current study were administered.

Results and discussion

Participant characteristics. The initial sample consisted of 106 participants of whom 100 completed all questions (77 women) and procedures. The participants varied in age from 18 to 38 years (M = 20.75, SD = 2.76).

Manipulation checks. One-way analysis of variance (ANOVA) showed that participants in the positive framing condition perceived the arguments as significantly more positive compared to participants in the negative framing condition; $F(1, 98) = 21.67$, p < .001, η_p^2 = .18 (M = 7.75, SD = 1.31 *vs.* M = 5.92, SD = 2.49). Likewise, participants in the negative framing condition perceived the arguments as significantly more negative compared to participants in the positive framing condition; $F(1, 98) = 16.31$, p < .001, η_p^2 = .14 (M = 4.85, SD = 3.11 *vs.* M = 2.67, SD = 2.25). The framing manipulation seemed to have been successful.

As in Study 1, it is analyzed whether the voices were actually perceived as male or female. Indeed, the female voice was rated as significantly higher in pitch compared to the male voice; $F(1, 98) = 59.49$, p < .001, η_p^2 = .38 (M = 4.30, SD = .76 vs. M = 3.06,

SD = .84). Both means differed from the midpoint of four, $p < .01$. In addition, the mean scores for speech rate and intonation were around the midpoint of four; *M* = 3.74 (*SD* =.77) and *M* = 4.00 (*SD* = 1.37), respectively, with the score on speech rate differing significantly from the midpoint of four ($p = .001$).

A manipulation check of the self-affirmation procedure should have been conducted right after the procedure (before exposure to the message). However, to prevent reactivity, no manipulation check was conducted regarding self-affirmation.

Main Analyses • *Effects on Source Reliability.* In an ANOVA, the three-way interaction in the saturated model (framing × self-affirmation × gender matching) on perceived source reliability was not significant; $F(1, 92) = .18$, *ns.* There were no significant two-way interactions either, but we found three significant main effects that were significant as well in a simplified model that only tested the main effects.

Firstly, the main effect of message framing, $F(1, 92) = 5.00$, $p < .05$, $\eta_p^2 = .05$, showed that the positive frame led to higher perceived source reliability (*M* = 5.77, *SD* = .75) compared to the negative frame (*M* = 5.47, *SD* = .70), which is in line with our expectation.

Secondly, the main effect of self-affirmation, $F(1, 92) = 4.97$, $p < .05$, $\eta_p^2 = .05$, meant that self-affirmed participants perceived the source as less reliable (*M* = 5.48, *SD* = .80) compared to when they were not self-affirmed (*M* = 5.79, *SD* = .63). When the voice as a peripheral cue is perceived as pleasant, invoking central processing will increase distance towards this peripheral cue, thereby lowering perceived source reliability.

Finally, the main effect of matching, $F(1, 92) = 5.01$, $p < .05$, $\eta_p^2 = .05$, showed that the source was perceived as more reliable after gender matching (*M* = 5.78, *SD* = .50) compared to mismatching (*M* = 5.46, *SD* = .90). This finding indicates that source gender is a relevant cue in evaluating source reliability among student participants. In sum, not only the perceived voice and person characteristics as addressed in Study 1, but also other message aspects may contribute to perceived source reliability in auditory persuasion.

• *Effects on Intention.* In an analysis of covariance (ANCOVA), the three-way interaction in the same saturated model with intention to eat more fruit and vegetables as dependent variable (and pre-test intention as covariate) was not significant; $F(1, 91) = .00$, *ns.* Two-way interactions were not significant as well. Only a significant main effect of framing was found; $F(1, 91) = 7.85$, $p < .01$, $\eta_p^2 = .08$: The positive frame led to a higher intention (*M* = 5.34, *SE* = 0.15) compared to the negative frame (*M* = 4.72, *SE* = 0.16).

As in Study 1, bootstrapping analyses were conducted to test whether perceived source reliability mediated the effect of message framing on intention (pre-test intention as covariate). The indirect effect was estimated and significance assessed via 95% confidence intervals (CI). The overall model was significant (adjusted $R^2 = .41$,

$F(3, 96) = 23.66$, $p < .001$), as well as the coefficient for the indirect effect of message framing on intention through the proposed mediator ($b = -0.15$, $SE = 0.09$, *95% CI* -0.36; -0.01) as the confidence interval did not include zero (Hayes & Preacher, 2014; Preacher & Hayes, 2008). In a causal theory, a positive message frame may increase perceived source reliability which may increase persuasion. However, with regard to self-affirmation and gender matching, this mediation could not be demonstrated.

General discussion

Participants seemed to be able to form an impression of source reliability based on hearing a voice only. Two different perspectives were used and combined to investigate the antecedents and consequences of perceived source reliability in auditory persuasion. The results in Study 1 showed that both background information (lower inference perceptions; the perception of a pleasant voice) and higher inference perceptions were related to perceived source reliability. These findings can be understood in terms of the reflection-construction model in which background information as well as constructed perceptions affect an overall source impression (Jussim, 1991). In addition, the relation between voice characteristics (speech rate and intonation) and perceived source reliability was mediated by three person characteristics. This suggests that without other information on the source, "how things are said" (e.g., intonation) and, partly based on this, how recipients interpret this (e.g., enthusiasm), contributed to ideas regarding the reliability of the source. The results in Study 2 showed that contextual factors were important as well in evaluating the source in auditory persuasion: message framing, level of processing (invoked by self-affirmation) and gender matching had an effect on perceived source reliability. These factors affected perceived source reliability independently; contrary to the hypotheses, no interactions were found. The source was perceived as more reliable after listening to a positively framed message, when no self-affirmation procedure was applied or when the message was communicated by a source of the same gender as the receiver. Furthermore, after listening to a positive frame, a higher intention to increase fruit and vegetable intake was reported. This was in line with our theoretical assumptions, formulated independently of the mode of persuasion (Rothman & Salovey, 1997). However, the effects of self-affirmation and gender matching did not transfer to persuasion, which is at least surprising as the effect sizes of all three main effects were similar. It may be that the quality of perceived source reliability or the context in which it is generated influences whether perceived source reliability is related to persuasion.

Based on the results of Study 1, we conclude that perceptions of both voice and person characteristics contributed to perceived source reliability. It is important to notice that this conclusion only holds when the "pleasantness of the voice" is conceptually grouped as a voice characteristic, as this was the only voice characteristic predicting

perceived reliability. Although this characteristic is based on few inferences and it seems a primary and direct evaluation of the voice (instead of the person), one could reason that it is a more complex and normative judgment compared to ratings of more "physical" voice characteristics, such as speech rate or voice pitch. Thus, it seems that there are alternative ways to interpret the data from Study 1 when the perception of a pleasant voice would not have been grouped as a voice characteristic.

Whereas the current studies increased our insight in auditory persuasion, it cannot be ruled out that similar effects would have been found using text-based messages. For instance, other peripheral cues will then be present, but this is most likely no idiosyncratic information on the source as is provided by the voice in auditory communication. These studies were however not designed to contrast the auditory mode with other modes; rather, they were exploratory in that the voice as peripheral cue was not contrasted with other peripheral elements. Future research could further study the uniqueness of the auditory mode of persuasion. For example, when the source is no longer presented by its voice, it is the question whether respondents still would have ideas about the source reliability, based on the peripheral cues available in textual forms of persuasion such as the number of arguments and the framing of outcomes (Petty & Cacioppo, 1984).

In Study 2, a match between the gender of the respondent and the speaker led to significantly higher perceived source reliability. It is unclear why this occurred given the null-finding in Study 1. It may be possible that gender becomes a more important cue in relation to negatively framed information (as used in Study 2), for example because negative information is basically relevant for survival (i.e., negativity bias; Siegrist & Cvetkovich, 2001). Or it might be that gender similarity as a group membership was not sufficient to evoke a feeling of perceived similarity with the source; attitudinal similarity may be a more relevant dimension of perceived similarity (Meijnders et al., 2009). The question whether (and for whom) a male or female voice is more efficient is especially relevant in (radio-) advertising and marketing contexts (Dwyer et al., 1998; Whipple & McManamon, 2002). The present studies did not aim to resolve this issue; further research might investigate the conditions under which gender matching in auditory persuasion is relevant.

A basic premise in persuasion research is that perceived source reliability is important as it influences persuasion. However, in Study 2, source reliability only mediated the effect of framing on persuasion, suggesting that the effect of voice-based perceived source reliability on persuasion may depend on the context. For example, the potential positive effects of source reliability may be overruled by other factors, such as defensiveness caused by content arguments (Sherman, Nelson, & Steele, 2000). This might be especially true for the domain of health; as most people value their health, persuasive health messages are always about relevant, mostly physical, outcomes. This issue needs further study.

The recordings used in the current study did not actually vary in pleasantness. A suggestion for further research is to vary the speech recordings in terms of pleasantness (or other voice characteristics) in order to test how this affects perceptions of source reliability and possibly, persuasion. These kind of experimental studies can provide us with more information on the possible causal link between these evaluations.

Some other limitations of our studies should be taken into account when weighing the results. For example, the actual content information and topic familiarity may have influenced source reliability evaluations. In addition, actor's specific voices are used and referred to, which clearly limits the generalization of the findings. We addressed this issue by choosing neutral voices to be regarded as "prototypical" without idiosyncratic and possibly distracting elements. At the same time, the influence of common idiosyncratic elements of human speech could not be addressed in this research. Moreover, we studied perceived voice characteristics, not so much the absolute effects of the unique voice. In addition, the subjective perception of a voice cue (e.g., voice pitch) is not only determined by the objective parameter (e.g., fundamental frequency). That is, the same fundamental frequency may be evaluated differently depending on the context, such as the source gender.

Another limitation refers to our measurement of intention. We asked respondents about their intention to eat more fruit and vegetables, and it is unknown how this is translated in future behavior. In addition, this question might have been interpreted differently by people who eat a little or a lot of fruit and vegetables already. People who already eat sufficient fruit and vegetables might indicate having a low intention to increase their consumption, which may have influenced the results. Yet, we do think that the own perception of eating sufficient or insufficient fruit and vegetables will actually contribute to the own formulation of a high or low intention to increase fruit and vegetable intake. Finally, it has to be acknowledged that the effects found in Study 2 were only small. Other factors that can affect the perception of source reliability and persuasion might overrule our effects. In the current context, truthful information is communicated by a neutral voice about a topic that is valuable and familiar to most people. With this, it is possible that the variance regarding these aspects (the topic and source) was already low and did not help people in their intention formation. All in all, these studies showed the complexity of studying how a voice affects perceptions and persuasion, as for example hearing a specific voice might (unconsciously) boost associations with other people's voices or stereotypes such as the vocal attractiveness stereotype (Zuckerman & Driver, 1989).

In sum, it seems useful for the field of (health) persuasion to take into account the possible influence of auditory persuasion. Perceived source reliability was studied in relation to perceived voice and person characteristics and contextual factors in persuasion. Although the studies have some relevant limitations, they increased our insight into auditory persuasion processes and may inspire future work in the domain of health.

Chapter 3

An experimental test of the relationship between voice intonation and persuasion in the domain of health

Abstract

In the process of behaviour change, intonation of speech is an important aspect that may influence persuasion when auditory messages are used. In two experiments, we tested to what extent different levels of intonation are related to persuasion and whether for some recipients the threat posed by the message information might become too strong to face. In Study 1, 130 respondents listened to a health message with either a low, moderate or high level of intonation. In Study 2 (N = 143), the same manipulations of intonation were applied but half of the respondents were affirmed before they listened to the persuasive message. Intention to increase fruit and vegetable intake was used as a dependent variable. Both studies showed that high intonation led to a significant drop in intention among respondents who perceived their own health as good. After self-affirmation, persuasion was increased. Thus, a high level of intonation seems to induce self-regulatory defences in people who do not see the necessity to change their health behaviour, whereas people with poor perceived health might perceive potential to change. The use of a normal level of intonation in auditory health messages is recommended.

▶ Chapter 3 is based on Elbert, S.P., & Dijkstra, A. (2014). An experimental test of the relationship between voice intonation and persuasion in the domain of health. *Psychology & Health,* 29(9), 1014-1031. doi: 10.1080/08870446.2014.903482

We would like to thank Elsemiek van Vendeloo for her contribution to the data collection for Study 2.

An experimental test of the relationship between voice intonation and persuasion in the domain of health

Commercial advertisements or health campaigns on the radio, help-desk employees and telephone sales persons; they all aim to persuade the recipient by voice. In these instances, no visual cues are available and the voice, speech and its characteristics become more salient and may have a prominent role in the persuasive process. Potentially relevant characteristics are speech rate, voice pitch, fluency, intensity and intonation. These characteristics of voice and speech have been found to be related to persuasion in varying degrees (Chebat, El Hedhli, Gélinas-Chebat, & Boivin, 2007; Gélinas-Chebat, Chebat, & Vaninsky, 1996; Ko, Judd, & Blair, 2006; Pittam, 1990; van der Vaart, Ongena, Hoogendoorn, & Dijkstra, 2005).

In this research, it is aimed to gain more understanding of the influence and working mechanism of intonation as a paralinguistic information cue associated with the source in the process of behaviour change (as defined in the Integrated Change Model; de Vries, Mesters, van de Steeg, & Honing, 2005). Therefore, the aim of these studies was to assess how intonation may influence respondents' behavioural intention when presented with an auditory persuasive health message.

Intonation of speech is a complex voice characteristic that can be defined as the variation in pitch while speaking. It is an indicator of speech melody, which has a 'particular communicative value' (Collier, 1990). When applied within a normal range, intonation provides information related to the grammatical and information structure of a sentence (Nolan, 2006). For example, the use of intonation helps the listener to organise the information and to understand a sentence or a message as a whole; it gives meaning to a sentence (whether it is a question or a statement) and it is used to emphasize particular words or ideas, especially by vocally stressing specific words (Nolan, 2006). This can be done by applying a rise or fall in pitch relatively to the prior or following words. For example, in the phrase, 'food can cause *serious* health damage' (in which 'serious' will be emphasized by a varying pitch relatively to the other utterances), the attention is drawn to the severity of the damage. Thus, intonation supports the receiver in the interpretation of utterances (House, 2006). Finally, intonation is also used to transfer information regarding attitudes and emotions of the speaker (Nolan, 2006; Rodero, 2010).

Intonation and persuasion

The effect of intonation on persuasiveness or related concepts (such as source credibility) has been investigated in different research areas, such as phonetics,

advertising and (tele)marketing (e.g., Gélinas-Chebat et al., 1996), showing mixed results. On the one hand, significant positive correlations have been found between intonation and persuasiveness, source status and solidarity (Pittam, 1990), and between intonation and purchase intention, especially under high involvement (i.e., when it concerns a relevant message; Gélinas-Chebat et al., 1996). Both outcomes represent a linear relation between intonation and persuasion: more intonation is related to more persuasion. On the other hand, in the same study, a negative relationship between intonation and source credibility was identified, again only under high involvement conditions (Gélinas-Chebat et al., 1996). This is in line with other studies that suggest there is an optimum of intonation in persuasion: To a certain extent a positive relationship between intonation and persuasion can be found, but an even greater rate of intonation (possibly, when the level of intonation is too high) may be associated with less persuasion and less influence, representing a curvilinear relation (Brooke & Ng, 1986; Chebat et al., 2007). The present studies aim to test this relation in the domain of health in an experimental design.

Defensiveness

It is proposed that intonation may influence persuasion as it provides non-verbal information apart from the verbal content, especially on the emotional meaning of the content (Rodero, 2010). In the absence of visual cues, recipients might use intonation to create mental representations of the persuasive outcomes; 'highly accessible mental images' that can motivate behaviour change (Cameron & Chan, 2008; Dijkstra & van Asten, 2014). That is, persuasive health messages are always related to relevant outcomes, for example, referring to the risk for cancer. When the recipient feels responsible or in control of these outcomes, a self-threat is induced: The state of feeling inconsistent, non-adaptive and inadequate (Steele, 1988). The self is held responsible and is evaluated negatively. According to self-affirmation theory (Steele, 1988), people are motivated to lower this aversive state. This can be done by accepting the health information and change the health behaviour in the advocated direction: higher intonation would lead to more persuasion. On the other hand, the self-threat may be dealt with by engaging in a defensive reaction towards the persuasive information. This reaction is primarily in function of restoring the self and can also be conceptualised as a fear control process (Leventhal, 1971; Maloney, Lapinski, & Witte, 2011). In other words, an 'emotional overload' caused by high intonation levels may lead to defensive reactions that inhibit persuasion (Block & Williams, 2002; Leshner, Bolls, & Thomas, 2009; Na, 1999). Thus, against this background, higher intonation would lead to less persuasion.

When there is a defensive reaction at work in function of protecting the self, a self-affirmation procedure should lower defences and increase persuasion after listening to a message with a high level of intonation. This will be investigated in Study 2.

Perceived own health

A next question is: 'In whom would higher intonation lead to defensive reactions?' People who perceive their own health as relatively poor or relatively good might react differently to a self-threat after listening to the relevant health outcomes. People with a poor perceived health status may relate the information (independent of the level of intonation) to their current state. For this group, the feelings of threat can be solved by adopting behaviour change as there is an opportunity to behave more healthily: The persuasive outcomes are perceived as congruent with the own need.

On the other hand, for people who perceive their own health as good, the communicated outcomes on fruit and vegetable consumption are incongruent with the own need, as there is no perceived immediate necessity to change. They already feel good and lack a readiness to change their behaviour. For this group, the feelings of threat are more likely to be solved by engaging in a defensive response than by adopting behaviour change. It is expected that a curvilinear effect of intonation will be found in people who perceive their own health as good: intonation might then induce a defensive response.

Study 1

In the context of auditory health persuasion, the relation between intonation and persuasion will be tested. Intonation was manipulated experimentally into speech with a low level of intonation, a medium level of intonation, and a high level of intonation. We expected to find a curvilinear relation between intonation and persuasion, but only in recipients who perceive their own health as relatively good. Specifically, it is hypothesised that a moderate level of intonation will lead to more persuasion compared to a low level of intonation (Hypothesis 1a) and a high level of intonation will lead to less persuasion compared to a moderate level of intonation (Hypothesis 1b). On the other hand, in respondents who perceive their own health as poor, level of intonation is not expected to lead to differences in persuasion.

The auditory persuasive message advocated sufficient fruit and vegetable consumption by presenting its gains (e.g., better physical stamina) and non-losses (e.g., lower risk for cancer). The message induced the awareness that oneself is responsible for missing out on these positive effects of the advocated behaviour (Rothman & Salovey, 1997). The intention to increase fruit and vegetable intake was the dependent variable. In general, intention is the best (albeit not perfect) predictor of behaviour (Sheeran, 2002), also in fruit and vegetable consumption (Pietersma & Dijkstra, 2011), and causally related to behaviour (Webb & Sheeran, 2006).

Method

Recruitment and design. This study investigated the influence of the independent variable intonation (low, moderate and high level of intonation) on persuasion in a 1 × 3 between-participants design. Self-reported health status was tested as a possible moderating variable. The research was conducted in the laboratory of the faculty of Behavioural and Social Sciences among students from the University of Groningen. Most of the participants (79%) received partial (first-year psychology) course credits; 21% of the participants were given a monetary compensation (€ 5) for completing the experiment.

Procedure. Participants were welcomed in the laboratory (individual cubicles). They were randomly assigned to one of three experimental conditions (low, moderate or high intonation) in order of registration and asked to evaluate an auditory (spoken) persuasive message regarding food habits. Assessments and manipulations were all presented on a computer. After an introduction screen, a screen with informed consent information was presented to the respondents, addressing the confidentiality of the research. Then, they were presented with the pre-test questions. Next, to ascertain that the level of volume of the actual health message was sufficient and convenient, an auditory recording was presented on volume regulation. While listening to this recording, participants could adjust the volume to their individually preferred level by using volume control buttons integrated in the headphone. Subsequently, they listened to a female speaker communicating a message on the benefits of fruit and vegetable consumption. Participants listened either to a message with a low level of intonation, a moderate level of intonation or a high level of intonation. After that, additional questions were asked, representing the manipulation check and the measure of persuasion. In total, the experiment took a maximum of 30 minutes and afterwards participants were dismissed and debriefed (via e-mail).

Persuasive message. The positively framed message comprised of 237 words (see Appendix 1a). The outcomes presented in the message were based on Dijkstra, Rothman, and Pietersma (2011): Both negative outcomes that can be prevented (e.g., lowered health risks) and positive outcomes that can be approached (e.g., increased physical stamina) are presented. The message presented two major positive physical outcomes of sufficient fruit and vegetable consumption: a decreased risk for cancer and for heart diseases. In addition, sufficient consumption was said to lead to looking more healthily, to slow aging, and to improve physical stamina and concentration on mental tasks. Two intermediary positive physical states were presented to be related to these consequences: low blood pressure and low levels of cholesterol. These effects were told to be related to increased intake of vitamin C and E.

Intonation manipulation. A female voice was selected in collaboration with a professional recording studio. Voices were excluded when they contained disturbing

elements or specific cultural habits, such as an accent. Furthermore, it was our intention to select a voice to be characterized as gender congruent; a woman with a feminine and high-pitched voice. Ultimately, an actress with sufficient control over her voice was selected and directed by the first author to produce three versions of the health message which varied on the dimension of intonation.

Voice pitch was measured as the mean fundamental frequency (F_0), whereas voice intonation was identified as the variation in pitch, operationalised as the within-subject standard deviation of F_0 (e.g., van Doorn & Sheard, 2001). In general, when level of intonation is very low, there is no or little variability between the low and high tones. This means that there is little pitch variation around the natural pitch of the speaker (the fundamental frequency) between the words spoken; the speech is potentially characterised as monotonous. On the other hand, a message with a higher level of intonation is spoken with a higher variability between the low and high tones; speech is potentially characterised as lively with 'more pitch variation reflecting the melodic contour' (Gélinas-Chebat et al., 1996).

There are two ways of experimentally manipulating a specific voice characteristic; either digitally while keeping the other voice parameters constant or by instructing actors to alter a specific voice characteristic while keeping the other cues as constant as possible in a more natural way (e.g., Gélinas-Chebat et al., 1996). By using a natural manipulation of intonation, we aimed to increase the ecological validity of the findings, related to the practice of auditory persuasion.

In the professional studio, the recording process started by recording the message in which the actress spoke as naturally as possible. This was considered as a moderate (default) level of intonation. The subjective manipulations of the other two versions were established by instructing the speaker to alter the intonation into lower and higher intonation 'within the persuasion bandwidth of acceptability'. That is, in persuasive communication there are expectations on what is normal and accepted (Burgoon & Burgoon, 2001); the recordings contained no unexpected intonation patterns. Thus, when heard on the radio, the high intonation would be within the bandwidth of acceptability. The low intonation was designed to still 'sound natural'.

The three versions (see Appendix 2, QR-codes 1, 3, and 4) were almost identical in terms of length; 114 seconds (low level of intonation); 106 seconds (moderate level of intonation); 111 seconds (high level of intonation). In addition, acoustical measures were performed to confirm each experimental condition objectively (see Table 3.1). To determine the acoustics, the 'Praat' voice analysis software version 5.1.34 was applied (Boersma & Weenink, 2000) using a .01 seconds interval of measurement. All parameters were set to the given recommendations, including a pitch floor of 75 Hz and a pitch ceiling of 600 Hz (Boersma, 2004; van der Vaart et al., 2005).

Table 3.1 Objective (acoustic) measures of speech rate, pitch and intonation in the three intonation conditions[a]

Level of intonation	Speech rate[b]	Mean pitch (Hz)	Intonation (Hz)
Low	3.54	153.22	25.33
Moderate	3.58	180.2	50.63
High	3.4	197.72	64.23

[a] speech rate was also manipulated in this study; for every level of intonation, the numbers are calculated as the mean of the acoustic measures for the slow, moderate and fast speaking conditions.

[b] measured in actually spoken syllables per second with a syllable script written in the software program 'Praat' (de Jong & Wempe, 2007).

Table 3.1 shows that in the low intonation condition the standard deviation of pitch was 25.33 Hz, in the moderate intonation condition it was 50.63 Hz, and in the high intonation condition it was 64.23 Hz. This indicates a linear increase in intonation as aimed to produce between the intonation manipulations. In addition, speech rate (syllables per second) was consistent across the three conditions, while the mean pitch in the three conditions increased with intonation. This latter finding suggests that intonation is more about including instances of high pitch in one's speech than of including instances of low pitch.

Measures. At pre-test, gender and age were assessed as demographic variables. Next, participants were asked to indicate to what extent they considered themselves as healthy (perceived own health status, based on CBS, 2013). This item could be answered on a six-point scale ranging from ('my health is…') 'very good' [1] to 'very bad' [6]. The item was recoded to ensure that high scores correspond with good health (M = 5.05, SD = .63). Then, intention to start consuming more fruit and vegetables in the next year was assessed with two items: 'I am planning to…within one year' and 'How likely is it that you…within one year?'. These items could be answered on five-point scales ranging from 'absolutely not' [1] to 'absolutely' [5]. The item scores were averaged to create a composite measure score of pre-test intention (r = .76, p < .001, M = 3.23, SD = 1.00). In addition, two items assessed perceived consumption of fruit and vegetables, respectively. These items could be answered on a five-point scale ('minimal' [1] / 'few' [2] / 'slightly insufficient' [3] / 'sufficient' [4] / 'more than sufficient' [5]). Again, a composite measurement was created (r = .33, p < .001, M = 3.53, SD = .75).

At post-test, perceived voice characteristics (voice pitch, intonation, and speech rate) were assessed with the following items: 'How was the intonation of the voice of the

speaker?' and 'The voice pitch / the speech rate of the speaker was…' Participants could respond to these 1-item measures on seven-point scales with item-specific endpoints, ranging from 'very monotonous' [1] to 'very lively' [7], 'very low' [1] to 'very high' [7] and 'very slow' [1] to 'very quick' [7], respectively. Then, process variables not pertinent to the present study were administered. Next, the main dependent variable, intention to start consuming more fruit and vegetables, was assessed with three items regarding the extent to which participants were planning to perform this behaviour in one month, six months, and five years respectively (α = .93, M = 4.48, SD = 1.62). To lower the probability of participants answering strategically (remembering their pre-test score), these items could be answered on seven-point scales ranging from 'absolutely not' [1] to 'absolutely' [7].

Statistical analyses. First, to assess the efficacy of the intonation manipulation, a one-way analysis of variance (ANOVA) was used with intonation as a between-subjects factor and the three perceived voice characteristics as dependent variables. To test the hypotheses, the interaction between intonation and perceived health status was tested using ANCOVA with post-test intention to increase fruit and vegetable intake as dependent variable and (standardised) pre-test intention and perceived fruit and vegetable intake as covariates. Perceived health status was included as a standardised continuous variable. To interpret the interaction, the main effect of intonation was tested within the two levels of perceived health status. To this purpose, the complete dataset was used to model a group with good perceived health and a group with poor perceived health, by adding and subtracting one standard deviation from the standardised mean scores on perceived health status, respectively (Cohen, Cohen, West, & Aiken, 2003).

Results

Participants and randomisation checks. The initial sample consisted of 150 participants, of whom 20 participants were excluded from the data-set (e.g., when reporting technical problems or when having participated in a previous study including the auditory message). The final sample consisted of 130 Dutch student participants (76.2% females), ranging from 17 to 32 years old (M = 20, SD = 2.71), randomly distributed over the conditions: Low intonation condition (n = 43); moderate intonation condition (n = 44); high intonation condition (n = 43).

Univariate analyses were conducted to analyse whether the conditions differed on relevant pre-test measures. No significant differences were found regarding the distribution of gender ($\chi^2(2) = 1.07$, p = .59), age (p = .75), pre-test intention (p = .58), perceived fruit and vegetable consumption (p = .35) and perceived own health status (p = .17). Still, all analyses regarding intention were performed while controlling for pre-test intention and perceived fruit and vegetable intake, as these variables are conceptually related to the reception of health messages.

Manipulation check. There was a significant linear effect of the intonation manipulation on perceived intonation in the expected direction, $F(2, 127) = 29.56$, $p < .001$, $\eta_p^2 = .32$: The higher the level of manipulated intonation, the higher the perceived intonation (low intonation condition, $M = 2.33$, $SD = 1.43$; moderate intonation condition, $M = 3.93$, $SD = 1.49$; high intonation condition, $M = 4.79$, $SD = 1.61$). Post hoc contrast analyses showed all three contrasts to be significant; *ps* < .01. In addition, the manipulated level of intonation had significant effects on the perception of voice pitch; $F(2, 127) = 24.06$, $p < .001$, $\eta_p^2 = .28$: The higher the level of manipulated intonation, the higher the perceived pitch. Again, all three contrasts were significant; *ps* < .02). Level of manipulated intonation had no significant effect on perceived speech rate ($p > .56$)[1]. These relationships are in line with the pattern as demonstrated by the objectively measured voice cues in Table 3.1.

Effects on persuasion. No significant main effect of intonation was found ($p > .14$), but the two-way interaction was significant, $F(2, 122) = 3.57$, $p < .05$, $\eta_p^2 = .06$. In case of good perceived health, level of intonation had a (marginal) significant effect on intention, $F(2, 122) = 2.90$, $p = .059$, $\eta_p^2 = .05$. The mean intentions in the low, moderate, and high intonation conditions were 4.49, 4.82, and 4.03, respectively, representing a curvilinear pattern, which is depicted in Figure 3.1. Intention in the high intonation condition was significantly lower compared to the intention in the moderate intonation condition ($p = .018$), supporting evidence for Hypothesis 1b. On the other hand, persuasion was not significantly higher in the moderate intonation condition compared to the low level of intonation condition, suggesting there is no direct evidence for Hypothesis 1a. A post-hoc polynomial contrast demonstrated that the quadratic trend was almost significant ($p = .051$), whereas the linear trend was not ($p = .14$).

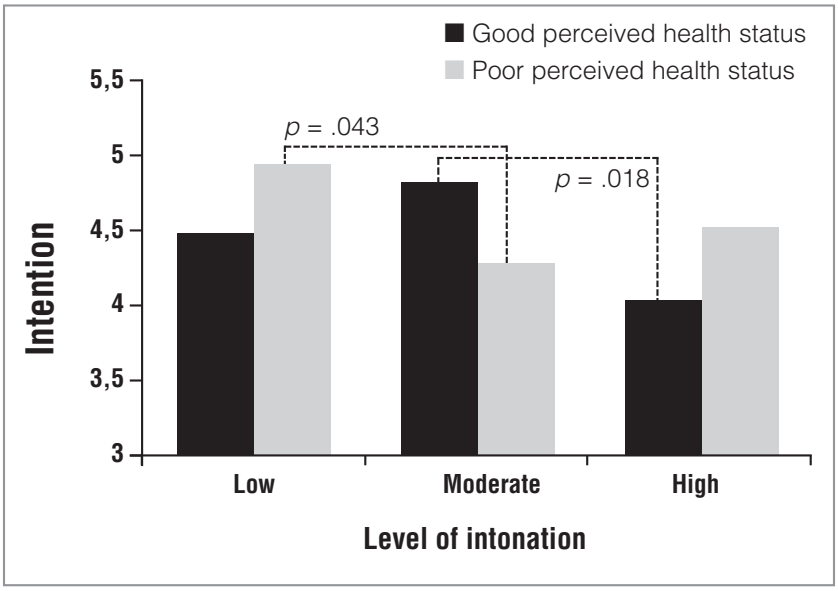
In case of poor perceived health, level of intonation had no significant effect on intention ($p > .12$)[2]. The mean intentions in the low, moderate and high intonation conditions were 4.94, 4.27, and 4.52, respectively (see Figure 3.1). An unexpected significant difference between the low and moderate intonation conditions was found

[1] Besides the manipulation of intonation, speech rate was as well manipulated in this study (slow, moderate and fast). Adding speech rate as a between-subjects factor to the model (including interaction term) did not affect the findings of manipulated intonation on perceived voice characteristics. In addition, no significant main effects of speech rate were found on perceived intonation and voice pitch ($p > .05$), except for perceived speech rate; $F(2, 121) = 93.92$, $p < .001$, $\eta_p^2 = .61$. The means showed a linear pattern as predicted with significant contrasts. The manipulation of speech rate did not have additional value in the context of the presented manipulation check.

[2] The model was also tested with speech rate as additional factor. The three-way interaction was not significant ($p = .35$), neither was the two-way interaction between speech rate and perceived health status ($p = .86$), suggesting that speech rate was redundant. Speech rate did affect the findings of manipulated intonation: The interaction between intonation and perceived health status became marginally significant after including speech rate ($p = .055$) and the effect of intonation in people who perceived their own health as good was not significant ($p = .20$).

($p < .05$). Furthermore, a post-hoc polynomial contrast showed that both the quadratic and linear trend were not significant ($p = .08$ and $p = .23$). Together, these findings give us a first indication of a curvilinear effect of intonation on persuasion, especially among respondents with good perceived health.

Figure 3.1 The effect of level of intonation on the intention to consume more fruit and vegetables for respondents with a poor and participants with a good perceived health status ▼



Study 2

The second experiment will attempt to replicate the findings of Study 1 and to unravel an aspect of the underlying process regarding the lowered persuasion after listening to a message with a high level of intonation. To examine whether this specific drop in persuasion can be interpreted as a defensive response after the aversive experience of a self-threat, self-affirmation was applied in half of the participants before listening to the persuasive message, as this procedure can prevent a defensive response (Epton & Harris, 2008; Harris & Napper, 2005).

In a self-affirmation procedure, important individual characteristics of participants are affirmed (McQueen & Klein, 2006). This makes people feel good about themselves; the procedure makes them realise that their self-worth does not hinge on temporary or situational evaluations of their self-image. Therefore, a self-affirmation procedure induces

a psychological state of 'open-mindedness'. The result is that people dare to face the potential threat and they accept the threat without denial (Harris & Napper, 2005; Sherman & Cohen, 2006). This leads to an increased potential for persuasion (Epton & Harris, 2008; Pietersma & Dijkstra, 2011).

As high intonation only lowered persuasion in case of good perceived health, self-affirmation can be expected to affect persuasion only in this group. In line with this reasoning, the starting point was the three-way interaction between intonation, self-affirmation and perceived own health status on persuasion. It is hypothesised that for recipients who experience the own health as good, a decrease in persuasion after high level of intonation is observed when no self-affirmation is applied (replication of Study 1), and that this decrease is prevented after self-affirmation (Hypothesis 2). This will inform us on the usefulness of the self-threat perspective in this specific context of auditory health persuasion.

Method

Recruitment and design. This study investigated the influence of the independent variables self-affirmation (self-affirmation versus no self-affirmation) and intonation (low, moderate and high level of intonation) on persuasion in a 2×3 factorial design. In addition, self-reported health status was tested as a possible moderating variable. The same auditory persuasive messages with the same manipulations of intonation as in Study 1 were used. The experiment was conducted in the laboratory of the faculty of Behavioural and Social Sciences among students from the University of Groningen. Most of the participants (88%) were given a monetary compensation (€ 5) for completing the experiment; only 12% of the participants received partial (first-year psychology) course credits.

Procedure. The procedure of this study was the same as in Study 1 with one exception: just before listening to the auditory message, half of the participants were exposed to a self-affirmation procedure. Participants were told that the study was about their values and interests and they were debriefed immediately after the experiment.

Self-affirmation manipulation. The self-affirmation procedure was based on the frequently used procedure of Allport, Vernon, and Lindzey's (1960) 'study of values' (e.g., McQueen & Klein, 2006; Sherman, Nelson, & Steele, 2000; van Koningsbruggen & Das, 2009). Participants were provided with six domains (theory, economics, aesthetics, social aspects of life, politics, and religion) and they selected both their most and their least valued domain. Next, respondents had to respond to ten dichotomous questions. In the self-affirmation condition, most of the questions included one option referring to the most important value of the respondent, providing the respondent with the opportunity to repeatedly choose answers reflecting their most important value, comprising the actual self-affirmation manipulation. In the no-self-affirmation condition

most of the dichotomous questions contained options concerning the least important value of the respondent.

Measures. The pre-test measures were the same as in Study 1. Perceived own health status was again recoded to ensure high scores corresponded with good health (M = 5.16, SD = .59). Composite measures of pre-test intention (r = .64, p <.001, M = 3.33, SD = .84) and perceived consumption of fruit and vegetables (r = .35, p < .001, M = 3.45, SD = .80) were created. At post-test, the participants' intention to increase fruit and vegetable intake was assessed with two items on the likelihood that they would start to consume more fruit and vegetables in the coming one month, and six months, respectively. These items could be answered on a seven-point scale, ranging from 'very unlikely' [1] to 'very likely' [7] and were averaged to create a composite measure of persuasion (r = .85, p < .001, M = 4.52, SD = 1.54). Then, the evaluation of the voice characteristics was assessed as in Study 1.

Statistical analyses. The same analyses as in Study 1 were applied. In addition, a one-way ANOVA was conducted to test the efficacy of the self-affirmation manipulation. The three-way interaction between self-affirmation, level of intonation and perceived health status was tested using ANCOVA with post-test intention as dependent variable. Perceived health status was included as a standardised continuous variable and the same covariates as in Study 1 were used. To interpret the interaction, the same procedure was used as in Study 1 (Cohen et al., 2003).

Results

Participants and randomisation checks. The initial sample consisted of 154 participants, of whom 11 participants were excluded from the data-set (e.g., when participated in a previous study including the auditory message). The final sample consisted of 143 participants (72.7% females), who varied in age from 17 to 31 years (M = 21.06, SD = 2.30); self-affirmation conditions: low (n = 24), moderate (n = 25), high (n = 20) level of intonation; no self-affirmation conditions: low (n = 26), moderate (n = 25), high (n = 23) level of intonation.

No significant differences were found regarding the distribution of all relevant pre-test variables: gender (χ^2 (5) = 3.55, p = .62), age (p = .21), pre-test intention (p = .47), perceived fruit and vegetable consumption (p = .91) and perceived own health status (p = .25). As in Study 1, all analyses regarding intention were performed while controlling for pre-test intention and perceived fruit and vegetable intake.

Manipulation checks. Again, participants' evaluations of the level of intonation differed significantly across the three conditions, F(2, 140) = 33.90, p < .001, η_p^2 = .33: low intonation condition, M = 2.46, SD = 1.15; moderate intonation condition, M = 4.14, SD = 1.55; high intonation condition, M = 4.72, SD = 1.45. Contrast analyses showed that all three contrasts were significant (p < .05). As in Study 1, the intonation

manipulation also affected the perception of voice pitch, $F(2, 140) = 18.39$, $p < .001$, $\eta_p^2 = .21$: again, the perception of voice pitch increased as the level of intonation increased. The same pattern was found for perceived speech rate ($F(2, 140) = 13.02$, $p < .001$, $\eta_p^2 = .16$). For both voice characteristics, the contrasts between the low and moderate, and between the low and the high intonation conditions were significant ($p < .05$). The mean scores on perceived voice pitch and speech rate did not differ between the moderate and high intonation conditions (*ps* > .25).

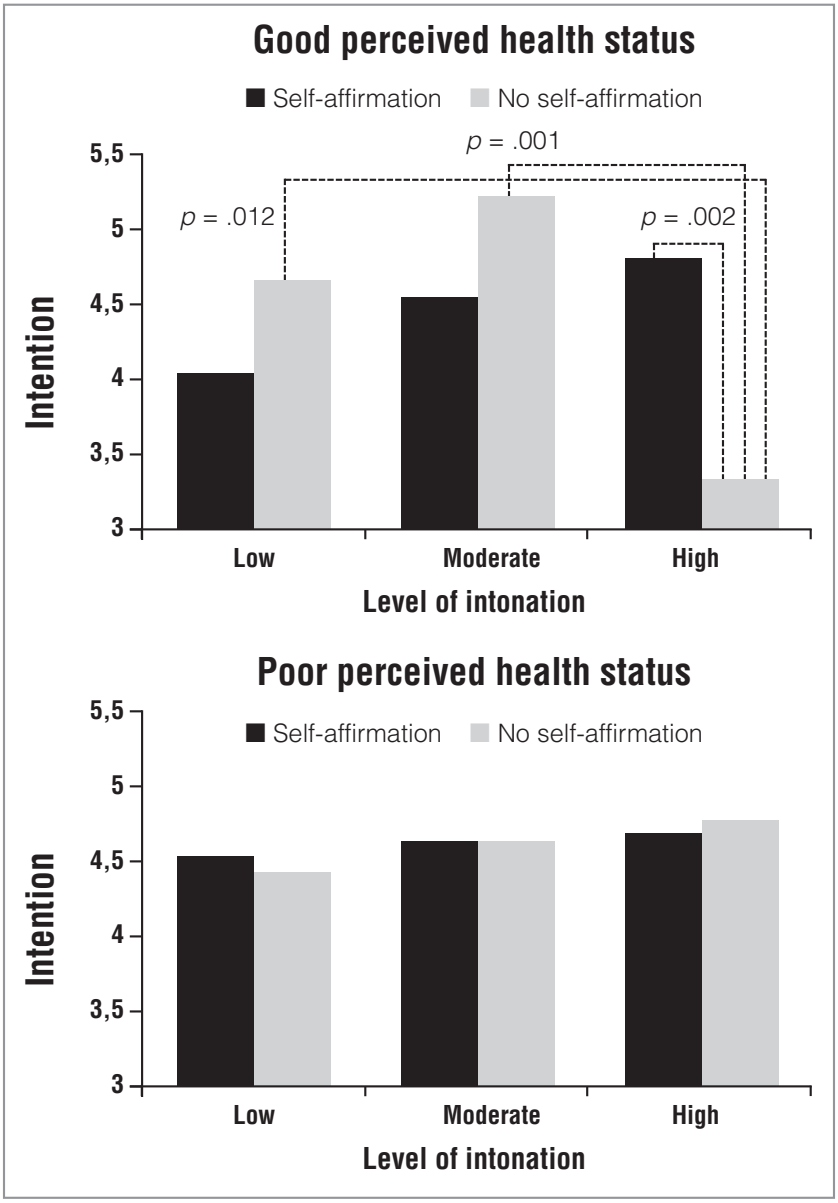
To test the efficacy of the self-affirmation manipulation (e.g., van Koningsbruggen & Das, 2009), we counted the number of times the manipulated value was chosen: a score of 1 was only given when respondents selected the option corresponding to the manipulated value (either their most or least important value). A composite measure was created, ranging from 0 to 10 with higher scores representing higher affirmation. Self-affirmed respondents selected the manipulated value more often ($M = 6.81$, $SD = 1.52$) than non-affirmed respondents ($M = 2.53$, $SD = 1.45$; $F(1, 141) = 299.11$, $p < .001$, $\eta_p^2 = .68$).

Effects on persuasion. The three-way interaction was significant, $F(2, 129) = 3.70$, $p < .05$, $\eta_p^2 = .05$. In addition, the two-way interaction of self-affirmation and intonation was marginally significant ($p = .081$), whereas the two-way interaction between self-affirmation and perceived own health, and the two-way interaction between intonation and perceived own health were not significant (*ps* .91 and .21, respectively). No significant main effects were found either.

Figure 3.2 displays the means in the six conditions for respondents modelled as having a poor and a good perceived health status. On the one hand, when perceived health status was poor, the interaction-effect between intonation and self-affirmation was not significant ($p = .97$). The mean scores in the six conditions were relatively high, ranging from 4.43 to 4.76 and no significant contrasts were found (*ps* > .44).

On the other hand, when perceived health status was good, the interaction between self-affirmation and intonation was significant ($F(2, 129) = 6.39$, $p = .002$, $\eta_p^2 = .09$). The main effect of intonation was marginally significant ($p = .070$). For this group, listening to a voice with a high level of intonation resulted in lowered persuasion when they were not affirmed ($M = 3.31$). When they were affirmed, persuasion was significantly higher ($M = 4.80$; $p = .002$), verifying Hypothesis 2. In addition, the curvilinear pattern found in Study 1 among participants with a good perceived health status was replicated: When no self-affirmation procedure was applied, persuasion in the high intonation condition was significantly lower ($M = 3.31$) compared to the moderate intonation condition ($M = 5.21$; $p < .001$) and the low intonation condition ($M = 4.65$; $p = .012$). The difference in persuasion between the low and moderate intonation condition was not significant ($p = .28$).

Figure 3.2 The effect of self-affirmation and level of intonation on the intention to consume more fruit and vegetables for respondents with a poor and good perceived health status ▼



Discussion

Two studies found that a high level of intonation lowered persuasion, but only in respondents who considered their own health as good. We explained the results from the self-threat perspective as Study 2 also showed that in these people, the self-affirmation procedure prevented the drop in persuasion. This suggests that the defences were in function of protecting the self, thereby inhibiting persuasion (Sherman & Cohen, 2006). In contrast, people with a poor perceived health status were not affected by the self-affirmation procedure, suggesting that there were no defensive processes at work in those respondents. Instead, they reported relatively high intentions to engage in behavioural change in all conditions. These results provide support for Hypothesis 1b and Hypothesis 2. On the other hand, Hypothesis 1a was not confirmed: No significant difference in persuasion between the low and moderate level of intonation was found (although this was significant for people with a poor perceived health status, in Study 1 only). Thus, the found pattern on persuasion was not so much curvilinear but the highest level of intonation did lower persuasion. In contrast, other research on the relationship between intonation and persuasion (Chebat et al., 2007) did not find significant differences in behavioural intention between a 'marked' intonation level and moderate or 'unmarked' intonation levels.

Although the measurement of underlying processes was limited, we explain these results in the following way. Firstly, after listening to the health message, it is reasoned that all recipients know that they are to some extent responsible for the risk of the negative outcomes and more or less, they might feel inadequate and non-adaptive. It is likely that this feeling of threat will be similarly present in people with poor and good perceived health, as perceived health status is not directly related to actual health behaviour. That is, people who see themselves as healthy do not necessarily eat sufficient fruit and vegetables.

Secondly, the reflection of a current health status is likely to determine whether behaviour change is perceived as necessary in the first place. Although it is not directly investigated in the current study, it is reasoned that the self-threat could be resolved by following the persuasive message. Then, the experienced need to change the feeling of threat might decide whether or not to engage in the health behaviour. When the recipients' health was perceived as good, it was resolved by a defensive response: It is acknowledged that the information is personally relevant (self-threat) but they feel no need to actually change. The information on health outcomes was incongruent with their behavioural tendency and need. However, when recipients feel not so healthy, it seems they transfer the self-threat into the direction of behaviour change, probably because the message was congruent with their need. Thus the occurrence of a self-threat, and the differences in handling the self-threat are thought to underlie the patterns of persuasion as found in the current study.

The few earlier studies that manipulated intonation also showed that the effects of intonation on persuasion-related variables were moderated: The effects differed for levels of involvement regarding the persuasive message (Gélinas-Chebat & Chebat, 1992; Gélinas-Chebat, et al., 1996). From the perspective of the elaboration likelihood model (Petty & Cacioppo, 1986), these authors argue that voice characteristics are peripheral cues that only influence persuasion when involvement is low, that is, when recipients are not so much interested in the content message. This hypothesis was supported in one study, showing that higher intonation lowered message acceptance when involvement was low (and when voice intensity was low as well; Gélinas-Chebat & Chebat, 1992). It may be that the moderator, perceived health status, is a parameter of involvement: perceiving one's health as poor may be an indicator of high involvement towards a message on the health effects of fruit and vegetable consumption. It would add to the explanation why in our study different levels of intonation only influenced persuasion in participants with a good perceived health status: they might have been less interested in the topic itself, (although they acknowledge that it is relevant to them) and were influenced by contextual features (level of intonation) of the content information.

As we did not directly assess all underlying processes (e.g., the self-threat), we cannot rule out that other basic mechanisms than self-threat played a role. For example, from an information processing and working memory angle, intonation increases the density of the information as more variation and, thus, more meaning is included in the message (Kitayama, 1996). More intonation may lead to a more transparent, clear and persuasive message but the limitations of the working memory might set a threshold: When the information becomes too dense, persuasion does not further increase or might even decrease because of an 'information overload' of the cognitive system (Basil, 1994). From a source evaluation angle, intonation may provide information about the source, for example about its credibility (e.g., Chebat et al., 2007). Increased perceived source credibility may subsequently increase persuasion (Pornpitakpan, 2004), but a high level of intonation may signal persuasive intent as well, that might work as a forewarning for the recipient (Lee, 2010; Petty & Cacioppo, 1977), thereby disturbing the persuasive process. Although the interpretation of the results and the patterns of persuasion that are found do not rule out explanations from the information processing perspective and the source evaluation perspective, we argue that the self-threat perspective is a sufficient explanation of the drop in persuasion in our studies (Harris & Napper, 2005; Sherman & Cohen, 2006).

The present results should be interpreted against the background of some relevant limitations. As the curvilinear relationship between intonation and persuasion was only partly confirmed by the data, the question arises whether a relevant difference between the low and moderate level of intonation was manipulated. However, these conditions showed large differences regarding both the objective acoustical measure of intonation

as reported in Table 3.1 and the subjective perceived level of intonation. Thus, despite the finding that participants - even in our between-subject designs - did notice the difference in intonation, it did not differentially influence persuasion. Our study may not have included the extreme low intonation that is associated with lower persuasion as all three intonation conditions were designed still to be in a normal or acceptable range.

Furthermore, there are indications that gender is relevant when it comes to persuasion (Whipple & McManamon, 2002). Here, in both studies a female voice was used: it cannot be ruled out that a male voice would have been differently related to a self-threat in the current context of auditory health persuasion. Another issue on the voice is that we used only one voice of one unique actress. Although the voice was selected to be a 'standard' voice without disturbing or deviating pronunciations and accents, it cannot be ruled out that other voices with unique characteristics should have led to other results. In addition, the participants were students, not necessarily representative of other populations but appropriate to join these studies on basic mechanisms in persuasion. Lastly, the dependent variable was the intention to increase one's fruit and vegetable consumption, not a behavioural measure. It is clear that not all people live up to their intentions and the intention-behaviour gap is renowned (Sheeran, 2002; Webb & Sheeran, 2006). However, it is the best predictor of behaviour available, and in an earlier study intention assessed immediately after exposure to the persuasive message predicted actual vegetable consumption one, and four weeks later (Pietersma & Dijkstra, 2011).

In the development of health interventions via the auditory channel (e.g., via MP3), two parameters (conditions) under which auditory persuasion can be effective were identified (Bartholomew, Parcel, & Kok, 1998; Schaalma & Kok, 2009). These parameters refer to aspects within the message (level of intonation) and the recipient (current perceived health status): Especially for people who perceive the own health as relatively good, high level of intonation can decrease persuasion. This suggests that auditory persuasion may not always be persuasive for everybody. Nevertheless, auditory persuasion has the potential to reach many people, for example, when provided through radio or smartphone applications, and small individual effects may then have large population effects. The present results contribute to our understanding of the processes involved in such large-scale population interventions.

Chapter 4

Background music in auditory health persuasion: Understanding the processes of distraction and identification with the music

Abstract

Persuasive health information can be communicated via an auditory channel and may include background music. Two working mechanisms (identification and distraction) that can explain a possible effect of the music conditions are investigated. It is expected that people who moderately value health will be mostly influenced by the background music, compared to people who view health as a top-priority. Students mentioned a song they would (not) put on their personal weblog as characterizing them as a person (positive versus negative identification). After 4-6 weeks, they listened to a health message either without background music, with the music they positively or negatively identified with, or with instrumental music that induced a positive mood (N = 146). When health was moderately valued, intention was significantly lower after listening to the message with positive or negative identifying music, which can be explained by distraction processes. It is recommended to apply background music carefully in auditory health education.

▶ Chapter 4 is based on Elbert, S.P., & Dijkstra, A. *(submitted)*. Background music in auditory health persuasion: Understanding the processes of distraction and identification with the music

Background music in auditory health persuasion: Understanding the processes of distraction and identification with the music

Besides music being a source of enjoyment and relaxation, it can be applied as a contextual cue in persuasion settings, such as advertisements or health messages. The widespread availability and use of the radio, the Internet and digital streaming technology (such as MP3) included in mobile phones and tablets shows that auditory forms of communication have become increasingly important and are broadly disseminated. This makes the potential value and reach of auditory communication channels enormous. In the present experimental study, background music will be applied in auditory health persuasion, to gain more understanding on two working mechanisms that can explain a possible effect of the applied background music. Background music might affect persuasion through the recipient's identification with the music while processing the auditory persuasive information. On the other hand, the music might affect persuasion negatively through distraction. The results may be relevant for health persuasion using new channels (such as the Internet) to design effective auditory health interventions but also for the development of (commercial) radio advertisements.

Recent research on the multidimensional functions of music (Boer et al., 2012), showed that the background function of music is closely linked to attentional processes such as focus enhancement, but also to value and identity development. Although music has become an important channel of communication and identity development and expression, for example in interpersonal contexts (Hargreaves & North, 1999; North & Hargreaves, 1999; Rentfrow & Gosling, 2006), this perspective has hardly been studied. Adolescents 'use music to express themselves and to make claims about their identity – public statements about who they are, who they want to be, and how they want others to perceive them' (Rentfrow, McDonald, & Oldmeadow, 2009; Hargreaves, Miell, & Macdonald, 2002), as they feel that their music preferences reflect who they are and what they value in life (Rentfrow et al., 2009; Schwartz & Fouts, 2003). This communication of music preferences is recently stimulated by online platforms that provide the explicit opportunity to present one's preferences, such as personal weblogs, social networking websites (e.g., Facebook, MySpace) and applications specifically aimed at music sharing (e.g., Spotify, Last.fm).

These aspects of music and personal identity expression form the central idea of the current paper. Two conditions of music identification will be created: One with background music the listener identifies with and one with background

music the listener explicitly does not identify with (positive vs. negative identification). If identification is a working mechanism in the relationship between background music and persuasion, specific differences between these conditions are expected. Positive identification with music may increase persuasion as the identification with the music "spills over" to the message, making the message more relevant to the self and lowering negative cognitive reactions towards the content. This might be related to the activation of the process of similarity testing (e.g., "This is who I am and this is where I belong"), which may lead to assimilation to the persuasive information (Mussweiler, 2001). In contrast, negative identification music may reduce persuasion as the music may lead to negative cognitive reactions that also influence one's evaluation of the persuasive message. This might be related to the activation of the process of dissimilarity testing (e.g., "This is not who I am"), possibly leading to contrasting and rejecting the persuasive information.

On the other hand, it is possible that identification processes are overruled by attentional processes (Westling, Mann, & Ward, 2006). That is, listening to background music generally leads to a higher cognitive load (Kiger, 1989; Perham & Vizard, 2011). In line with this, the elaboration likelihood model (ELM; Petty & Cacioppo, 1986; Petty & Briñol, 2012) suggests that cognitive reactions towards the persuasive information can be disturbed by distraction (e.g., while listening to the music; Baron, Baron, & Miller, 1973; Petty, Wells, & Brock, 1976; Keating & Brock, 1974). This means that distraction can either negatively or positively affect persuasion: Distraction from positive cognitive reactions (i.e., a message containing strong arguments) may reduce persuasion, whereas distraction from negative cognitive reactions (i.e., a message containing weak arguments) may increase persuasion (Petty et al., 1976; Petty & Briñol, 2012). In the current study, a message with strong arguments is used; therefore, it is expected that distraction might lead to less persuasion.

Besides the above presented opposing processes (identification versus distraction), individual differences might moderate the effects: The level of personal involvement in the message is thought to affect the patterns of persuasion as well. In the domain of health, the extent to which health is valued may be considered a measure of value involvement (Eagly, 2007; Johnson & Eagly, 1989). As most people value health, we distinguish between people who value health as top priority in their lives (high health value) and people who acknowledge that health is important, but not the most important value in life (moderate health value; Pietersma & Dijkstra, 2011). Based on the ELM (Petty & Cacioppo, 1986), it can be expected that people who are highly involved in the topic will process the information centrally. This group is motivated to focus on the content information that is in line with their value, and is probably less affected by the background music. In contrast, people who are moderately involved in the topic are less motivated to pay attention to the content information and might

focus more on the peripheral cues instead (i.e., the background music). In line with this, it can be expected that significant differences between types of background music will be observed for moderately involved participants only (interaction effect - Hypothesis 1).

In sum, the effect of background music that people identify positively or negatively with will be investigated in auditory health persuasion. The music is applied as an additional auditory cue to the primary task - listening to a health message - which implies that multiple levels of information are processed simultaneously via the auditory channel. In addition, a control condition without background music will be added.

When identification processes are at work, positive identification with background music will lead to more persuasion compared to negative identification and the control condition (Hypothesis 2a). This pattern will be most pronounced in recipients who value their health moderately. On the other hand, these effects may be overruled by distraction processes: We would then expect that whatever background music is applied, it distracts from the persuasive message and lowers persuasion. Persuasion will then be most high in the control condition without background music (Hypothesis 2b). Again, health value may moderate the effects. Besides identity construction and distraction, mood is another relevant and robust mechanism through which music can affect persuasion (Hullett, 2005; Västfjäll, 2002). In addition, recent research suggests that positive mood is a resource to process self-relevant health messages (Das, Vonkeman, & Hartmann, 2012). Therefore, a condition will be included in which participants listen to music that is known to elicit a positive mood to exclude this as an alternative explanation. Persuasion is operationalized as the intention to eat more fruit and vegetables and process measures of identification, mood, negative cognitive reactions and distraction will be assessed.

Method

Recruitment and design. At different university locations in Groningen, students were asked to participate in a study consisting of an online questionnaire and a lab experiment. If they agreed to participate, they were asked to write down the e-mail address for receiving the questionnaire and to give an indication of when they could finish the experiment. If they could not indicate this, they were contacted by phone or e-mail in order to make an appointment. The experiment took place in the laboratory of the Faculty of Behavioral and Social Sciences among students. Participants received 10 Euros after completing both parts. Once the online questionnaire was completed, participants were randomly assigned to a condition. The between-participants design consisted of four conditions: Besides the positive identification music and negative identification music conditions, a control condition with no background music was added, as well as a condition with a piece of music that is known to elicit a positive mood (Mozart's Sonata for Two Pianos; Thompson, Schellenberg, & Husain, 2001).

Procedure. Participants received a link to a fifteen minute online questionnaire that could be filled in at home. Among background variables, the questionnaire included five short scenarios for which the respondent was asked to mention a song that applied to him or her in the given situation. This individual information was used later to compose the experimental manipulations for those assigned to either the positive or negative identification background music condition.

Four to six weeks after completing the online questionnaire, participants were scheduled for the lab experiment. Once the participants arrived, they were welcomed and allocated to one of four individual cubicles in the laboratory. The manipulation and assessments were all accessible via a computer. They were introduced to the study by a screen with an informed consent form, addressing the confidentiality and duration of the study (approximately 10 minutes). Auditory instructions on adapting the volume of the headphone were given. Then, the health message accompanied with a specific piece of background music (based on pre-test measures), the piano music or no background music was presented to the participants, after which several questions were asked, representing the dependent variables. Finally, an on-screen debriefing was presented to the participants.

Materials and measures • *Pre-test measures.* The first part of the online questionnaire referred to socio-demographic variables, such as gender and age. In addition among general background variables regarding music and lifestyle, it was assessed whether participants currently played a musical instrument, which could be answered with yes or no. Next, for different situations, respondents were asked to name a specific song (artist and title) that applied to them personally, without providing restrictions. The first scenario was the basis for the positive identification manipulation: 'Assume you have a personal weblog and you can indicate one song that defines you as a person, which song would you choose?' The second scenario referred to the negative identification manipulation: 'What could be a popular song that you would never put on your personal weblog, but somebody else might?' Additionally, three filler items were created with different situations for which the respondents could mention an applicable song (i.e., a song that cheers you up when feeling down).

Intention to change health behavior was assessed with one item: 'It is likely that I will eat more fruit and vegetables within one year', that could be answered on a five-point scale ranging from 'absolutely not' [1] to 'absolutely' [5] (M = 2.98, SD = .97). Subsequently, two questions regarding the respondent's health value were asked. The first question referred to how valuable health was for the respondent and could be answered on a seven-point scale ranging from 'not very valuable' [1] to 'very valuable' [7]. The second item stated that health is most important to the participant and could be answered on a five-point scale ranging from 'totally disagree' [1] to 'totally agree' [5]. A composite measurement was created by averaging both items (r = .36, p < .001,

M = 4.81, *SD* = .78). Finally, two items addressed perceived consumption of fruit and vegetables, respectively, that could be answered on a five-point scale ('minimal' [1] / 'few' [2]/ 'slightly insufficient' [3]/ 'sufficient' [4]/ 'more than sufficient' [5]). Again, a composite measurement was created (r = .27, p = .001, *M* = 3.43, *SD* = .76).

• ***The health message.*** The auditory message itself (242 words, 111 seconds; see Appendix 1b and 2, QR-code 5) was recorded in collaboration with a professional recording studio and spoken by a female voice that was selected because of her neutral sound. The content of the message referred to the negative outcomes of eating an insufficient amount of fruit and vegetables, such as an increased risk for cancer and heart diseases. In the positive identification condition 37 unique songs were used (among which two instrumental), whereas in the negative identification condition six songs were mentioned multiple times (25 unique songs, one instrumental). No overlap between the conditions was observed. The selected pieces of music of the participants allocated in the positive or negative identification condition were purchased via iTunes to keep the quality of the background music as constant as possible.

For each participant in one of the two identification conditions, (a recognizable part of) the music was composed together with the spoken health message in collaboration with the recording studio. The volume of the music was adapted to ensure that it was not too high or too low relatively to the voice; the respondent had to be able to listen to the message, while also recognizing the music for the sake of the identification manipulation. At the beginning and the end of the recording, the songs were faded in and out to create a moment of recognition and to enhance a natural recording (to ensure it did not start or end unexpectedly). Respondents could only adjust the default level of the message prior to listening, whereas they could not adjust the relative volume differences between the health message and the music.

• ***Post-test measures.*** First, mood was assessed with three questions (α = .76, *M* = 5.29, *SD* = 1.00), encompassing the question: 'What is your mood at the moment?' It could be answered on three different seven-point scales, ranging from 'not positive' [1] to 'very positive' [7], 'not negative' [1] to 'very negative' [7] or 'bad' [1] to 'very good' [7]. Scores on the second question were reversed to create a coherent measurement: A higher score corresponds with a better mood.

Identification was measured with three questions that could be answered on seven-point scales (α = .65, *M* = 3.12, *SD* = 1.44). The first question addressed the extent to which the respondent felt a connection with the fans of the band or artist that he or she heard a song of ('not at all' [1] - 'very strong' [7]). It was tailored to the specific band or artist mentioned at pre-test either at the negative identification item (when the respondent was in the negative identification condition) or at the positive identification item (for all other conditions). The second question assessed the extent to which the respondent identified him/herself with the background music ('not at all' [1] - 'very

strong' [7]) and the third question was: 'To what extent is the background music typical for who you are as a person?' ('not at all typical' [1] - 'very typical' [7])[1].

The strength of negative cognitive reactions was assessed with one question: 'To what extent did you have negative thoughts regarding the message content?' It could be answered on a seven-point scale ('not at all negative' [1] to 'very negative' [7]; $M = 2.59$, $SD = 1.53$).

Two questions measured self-reported distraction that could be answered on seven-point scales with endpoints 'not at all' [1] and 'very much' [7]. The items are 'To what extent did the music distract you from listening to the health message?' 1 and 'To what extent did you manage to keep your attention to the health message?' The second item was recoded to create a coherent measure with a high score referring to high distraction ($r = .56$, $p < .001$, $M = 3.85$, $SD = 1.46$).

Finally, two questions assessed intention to change the health behavior. Participants responded to the statement: 'It is likely that I will eat more fruit and vegetables' in two different time frames ('within one month' and 'within five years', see also Ajzen, 1988). To lower the probability of participants answering strategically (remembering their pre-test score), these questions could be answered on seven-point scales ranging from 'not at all probable' [1] to 'very probable' [7] ($r = .52$, $p < .001$, $M = 4.35$, $SD = 1.51$).

Results

Participants and randomization check. In total, 179 participants completed the online pre-test questionnaire. Eighty-five percent of them completed the lab study as well ($N = 152$). Six participants were excluded from the dataset[2]; the final sample consisted of 146 participants, of whom 69 females (47%). Recipients were 17 to 34 years old ($M = 21.4$, $SD = 2.4$), and randomly distributed over the conditions: Positive identification ($n = 37$); negative identification ($n = 36$); positive mood ($n = 36$); no music ($n = 37$).

ANOVAs showed that with regard to age, pre-test intention, health value, perceived fruit and vegetable intake and gender (Chi-square), there were no significant differences between conditions (all F's (3, 142) < 2, $ps > .20$ / $\chi^2(3) = 4.51$, $p > .20$). However, 'playing a music instrument' was not randomly distributed across conditions; $\chi^2(3) = 10.34$, $p = .016$. All subsequent analyses were performed while controlling for this, but no differences in significances were found. Therefore, we will report the results without controlling for this variable.

[1] When a participant was assigned to the control condition, these questions referred to the voice instead of the music (e.g., 'To what extent is the voice of the speaker typical for who you are as a person?')

[2] Four respondents in the identification music conditions made explicit statements about the music that did not fit with the condition they were assigned to. The central aspect of the manipulations (a sense of identification) was not successfully induced and these responses were considered as deviating. In addition, one respondent participated in a previous study that included the auditory message and one respondent reported technical problems while listening.

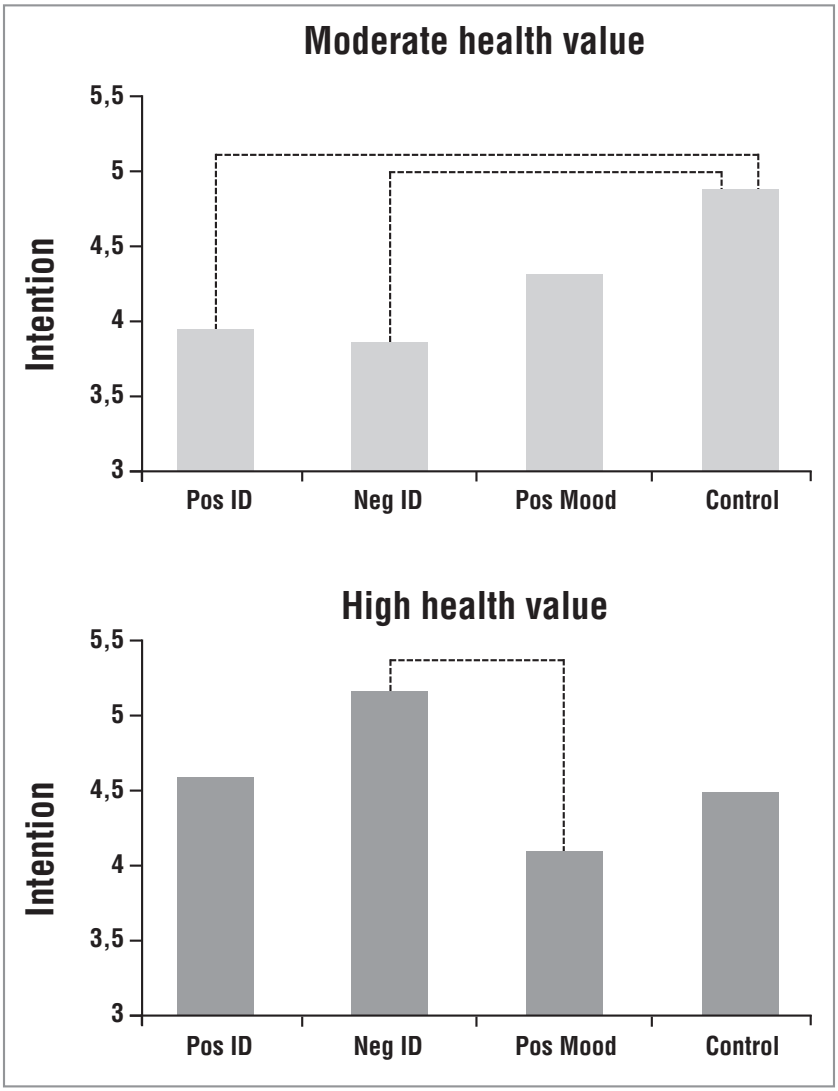
Manipulation check. It was analyzed whether the positive and negative identification conditions differed from each other on self-reported identification. A significant main effect of condition was found, $F(3, 142) = 51.09$, $p < .001$, $\eta_p^2 = .52$. The mean score in the positive identification condition ($M = 4.68$, $SD = 1.08$) was higher than the mean score in the negative identification condition ($M = 1.80$, $SD = 1.02$), $p < .001$. In addition, the mean identification in the positive identification condition was significantly higher than the means in the positive mood condition ($M = 3.12$, $SD = 1.05$) and the control condition ($M = 2.86$, $SD = .86$), $ps < .001$. Moreover, the mean score in the negative identification condition was significantly lower than the means in the positive mood and no-music conditions, contrasts $p < .001$. These data suggest that the identification manipulation by means of music was successful.

Effects on Intention. An ANCOVA was conducted to analyze the interaction between condition and (standardized) health value on intention to eat more fruit and vegetables. Pre-test intention and perceived own consumption of fruit and vegetables were standardized and added as covariates. As predicted, a significant interaction of health value and condition was found, $F(3, 136) = 3.30$, $p < .05$, $\eta_p^2 = .07$, suggesting that the effect of the background music manipulations differed for respondents scoring low or high on health value. The complete dataset was used to model participants as scoring relatively high or low (moderate) on health value, by adding and subtracting one standard deviation to the standardized means, respectively (Cohen, Cohen, West, & Aiken, 2003). To interpret the interaction, simple main analyses were conducted.

When health value was moderate, the effect of condition was marginally significant ($p = .081$). Both means on intention in the positive identification ($M = 3.94$) and the negative identification condition ($M = 3.86$) were significantly lower compared to the mean in the no-music control condition ($M = 4.87$), $ps < .05$. The mean score in the positive mood condition ($M = 4.30$) fell in-between those scores and showed no significant differences (Figure 4.1).

When health value was high, the effect of condition was not significant ($p = .14$) and relatively high intentions to change the health behavior were observed across conditions. The means were as follows (see Figure 4.1); positive identification: $M = 4.56$; negative identification: $M = 5.12$, positive mood; $M = 4.06$; no-music: $M = 4.43$. One contrast was significant: Respondents in the negative identification condition reported a significantly higher intention compared to respondents in the positive mood condition ($p < .05$).

Figure 4.1 Interaction effect of condition and self-reported health value on the intention to increase fruit and vegetable consumption ▼



Within the current analysis, the dependent variable was the intention to eat more fruit and vegetables. This question is possibly interpreted differently by respondents who already indicated that they consume sufficient fruit and vegetables. Indeed, our sample also included respondents who indicated at pre-test to perceive their fruit intake and / or their vegetable intake as 'sufficient' or 'more than sufficient'. Therefore, we further analyzed the result in a selection of respondents who scored lower than 'sufficient' for at

least fruit or vegetable consumption (n = 106). The interaction between condition and health value was still significant, $F(3, 96) = 3.08$, $p < .05$, $\eta_p^2 = .09$. In case of moderate health value, the effect of condition was now significant ($p < .05$). The same pattern was found, as both the means on intention in the positive identification ($M = 4.20$) and in the negative identification condition ($M = 4.17$) were significantly lower compared to the control condition without background music ($M = 5.26$, $p = .025$ and $p = .007$, respectively). In case of high health value, no significant effect of condition was found ($p = .51$), and there were no significant contrasts either. The means were relatively high for recipients with a high health value, ranging from 4.59 to 5.16.

Effects on Process Measures[3]. None of the effects of condition on the process measures (including identification as mentioned before) was moderated by health value. Therefore, only main effects are reported below.

• ***Mood.*** The effect of the music manipulation on mood was marginally significant; $F(3, 142) = 2.44$, $p = .067$, $\eta_p^2 = .05$. Mood was rather positive in all conditions. A significant difference was found between the mean score in the positive identification condition on the one hand ($M = 5.65$, $SD = .87$) and the mean scores in the negative identification condition ($M = 5.10$, $SD = 1.21$) and the no-music condition on the other hand ($M = 5.12$, $SD = .85$; $ps < .05$). However, none of these three means differed significantly from the mean score in the positive mood condition ($M = 5.27$, $SD = .98$).

• ***Negative cognitive reactions.*** Regarding negative cognitive reactions, a significant effect of condition was found, $F(3, 142) = 4.83$, $p < .01$, $\eta_p^2 = .09$. The effect is mostly expressed by the high mean score in the negative identification condition ($M = 3.22$, $SD = 1.85$), which is significantly higher than the mean scores in the positive identification condition ($M = 2.00$, $SD = 1.08$, $p < .01$) and the positive mood condition ($M = 2.33$, $SD = 1.27$, $p < .05$). In addition, the mean in the positive identification condition was significantly lower than the mean in the no-music control condition ($M = 2.81$, $SD = 1.58$; $p < .05$).

• ***Distraction.*** A significant effect was found on distraction, $F(3, 142) = 20.57$, $p < .001$, $\eta_p^2 = .30$. High self-reported distraction was found in the positive and negative identification condition ($M = 4.66$, $SD = 1.17$ and $M = 4.57$, $SD = 1.13$, respectively). Both means do not differ significantly from each other, but they do differ significantly from the means in the positive mood condition ($M = 3.38$, $SD = 1.40$) and the no-music control condition ($M = 2.78$, $SD = 1.20$), $ps < .001$. In addition, the mean score in the positive mood condition was significantly higher than the mean in the no-music control condition ($p = .042$).

[3] In line with the identification construction and emotional induction functions of music, it can be reasoned that more positive generated feelings towards the self, such as confirmation and affirmation, were generated after listening to positive identification music. Indeed, affirmation was taken into account as a process variable. No significant main effect of condition on affirmation was found, neither an interaction with perceived health value ($ps > .05$).

To explore the relation between self-reported distraction and persuasion, correlations between these constructs were computed, controlling for standardized pre-test intention and perceived fruit and vegetable intake. In the positive mood music condition there was a positive correlation (r = .32, p = .07), whereas in the positive and negative identification music conditions the correlations were negative (r = -.36, p < .05 r = -.31, p = .071, respectively). Furthermore, in the no-music control condition, this correlation was non-significant (r = .03, p > .83).

Based on the above analyses, several mediations could be possible. Multiple mediation analyses were conducted (Hayes & Preacher, 2014) to test whether identification, negative cognitive reactions, distraction or mood mediated the effect of condition on persuasion. Pre-test intention, perceived fruit and vegetable consumption and health value were standardized and included as covariates. Bootstrapping was applied (using 5000 resamples) to estimate the indirect effects and to assess their significance via 95% confidence intervals (CI). The overall model was significant; adjusted R^2 = .19, F(8, 137) = 4.09, p < .001, revealing the above reported effects of condition. However, the indirect effects and CI showed that all four possible mediations were not significant (as the CI did include zero; Preacher & Hayes, 2008).

Discussion

The relation between background music and persuasion was investigated in the context of auditory health persuasion. Although identification processes are induced (as shown by the manipulation check), the results suggest that Hypothesis 1 and 2b can be confirmed: Effects of the background music were mostly found in participants who moderately valued their health. In addition, identification did not seem to have effects on persuasion in this study, but it led to distraction instead. The results on persuasion could be interpreted while taking into account these processes of distraction. Participants with a moderate health value reported a significantly lower intention after listening to either positive or negative identifying music compared to when there was no background music. This pattern was also found in a selective sample of recipients who reported either insufficient fruit or vegetable intake. It may be reasoned that for these recipients the intention measures applied mostly, as these people might perceive there is still room for them to increase their fruit and vegetable consumption. Despite the smaller number of participants, the effect was even stronger in the selective sample, which increases the validity of this finding.

All participants reported more distraction in the three background music conditions compared to the no-music control condition, which is in line with the notion that background music can distract from the content message (Furnham & Bradley, 1997; Kiger, 1989). The finding that there was no significant difference between the positive and negative identification condition on distraction suggests that distraction was

independent of identification. In addition, both identification conditions led to the strongest perceived distraction, stronger than the mood condition.

The correlations between persuasion and reported distraction underline the differences between the mood condition and the identification conditions. In the positive mood condition the correlation was positive: The more distraction, the more persuasion. However, in both identification conditions the relation was negative. Thus, while attending to the positive mood music supported persuasion, attending to the identification music inhibited it. It seems that certain characteristics of the identification music, either positive or negative, may have disturbed persuasion. Typically, most songs in the identification conditions included lyrical components; it may be that these voices were the main distractors. In addition, research indicates that structural features of music can produce emotional effects. For instance, fast tempo is associated with positive, high-arousal emotions such as happiness (Bruner, 1990; Gagnon & Peretz, 2003; Niedenthal, Krauth-Gruber, & Ric, 2006). Structural musical features have been found to be related to distraction as well (Kallinen, 2002; Thompson, Schellenberg, & Letnic, 2012). Although we controlled for the loudness of the background music, we did not control for other characteristics of the music as the songs were selected primarily for their positive or negative identification value. In future research, to rule out some variation, one might select background music that is expected to be either positively or negatively identifying for respondents in general.

We can understand why the background music led participants to report distraction. But can distraction also explain the results on persuasion? Although participants with moderate and high health value were distracted by the conditions in similar ways (there was no moderation of health value), they were differentially persuaded by the conditions. This suggests that the reported distraction worked out differently in those with moderate and high health value. Those with moderate health value do value health and they do recognize that the persuasive arguments relate to this value. However, because health is not their top-priority they are not ready to invest in health behavior change and rather hold off the confronting information (Pietersma & Dijkstra, 2011). This may provide them with a motive to give in to the distraction by the music, at the cost of listening to the persuasive message. Those with high health value, however, may report an evenly large distraction but not give in to it as the content information is in line with their top-priority, health. Our measure of distraction referred to self-reported "distraction from listening": More advanced means of measuring distraction should be applied in future research.

In discussing the above issue on distraction and persuasion it is important to realize that the persuasive information as well as the background music were offered in an auditory format. In Baddeley's (2000) theory, the working memory is composed of three subsystems: The auditory/verbal system, the visuospatial system, and a central

executive. In this model, information input from two sources may interfere with each other, especially when they are processed through the same subsystem (as in the present study, the auditory/verbal system; Dittrich & Stahl, 2012). This notion may be used to further disentangle the effects of background music on different types of persuasion (auditory, textual, pictorial).

Based on the elaboration likelihood model (Petty & Cacioppo, 1986; Petty & Briñol, 2012), it was expected that recipients who viewed health as top priority would be less affected by the background music. Yet, the results were not in line with this expectation; these recipients reported a significantly higher intention after negative identification music compared to the positive mood music. It seems contradictory to report high persuasion after listening to music the respondent explicitly mentioned to negatively identify with. These respondents, who are motivated to listen to the content as it is in line with their top-priority, might have had an extra motive to ignore the background music and listen to the content instead, which led to more persuasion. It might be that they cognitively decided to block the negatively associated music early in the information processing (Kiger, 1989), as it is not rewarding to pay attention to the negatively identifying music compared to the other background music conditions. Thus, as might be investigated in future studies, in those who highly value their health, background music that people are motivated to avoid may increase central processing.

Besides identification and distraction, mood and negative cognitive reactions were assessed as potential mediators. However, for none of these four variables a mediation function could be demonstrated which, firstly, limits the extent to which the above causal statements regarding the relationship between distraction and persuasion are legitimized. Secondly, based on the literature, it could be expected that listening to music that elicits a positive mood would lead to more persuasion compared to when there is no background music available (Hullett, 2005). However, we were not able to show such an effect in the current context. One significant contrast was found between the positive and negative identification conditions in understandable direction, suggesting that positive and negative identification affected mood. This is in line with data from the field of social identity showing that activating group constructs in the face of negative feedback – as the persuasive message can be regarded as – led to a more positive mood (Knowles & Gardner, 2008). The other potential mediator, self-reported negative cognitive reactions, was most high in the negative identification condition and most low in the positive identification condition. This seems to further verify the manipulated difference in valence between the conditions but cognitive reactions had no relation with persuasion or distraction.

Some limitations of the current study should be taken into account. Firstly, the participants were students, not necessarily representative of other populations but appropriate to join this study on basic mechanisms of identification and background

music in persuasion. In addition, the music in both identification conditions strongly varied and was highly idiosyncratic. The same piece of music pointed out to lead to positive identification in the one condition could have been chosen as negative identification music in the other condition. As music preferences exist within a holistic setting in which identification and emotional associations naturally co-occur, we approached it accordingly; as an idiosyncratic aspect of a person's identity, in which memories and repetition could have played a role as well (Niedenthal et al., 2006). Furthermore, to stimulate a sense of either positive or negative identification, we decided to ask the respondents to mention a song themselves and not to provide them with a selection. Yet, the self-mentioned music may have affected enjoyment and liking independent from the valence of identification and therefore may have influenced the results (Cassidy & Macdonald, 2009). Finally, further research may include a thought listing procedure to measure negative cognitive reactions potentially in a more reliable and valid way. In addition, a follow-up study on actual reported fruit and vegetable consumption may be included to assess how long the effects will last and whether the reported intention will transfer to behavior as well.

In the present study, we aimed to gain knowledge on auditory health persuasion in general and more specifically on the working mechanism of background music. The data suggest that the addition of background music is not beneficial for everyone. These insights regarding the effects of background music might be taken into account in the future development of effective auditory health interventions, radio (health) campaigns or advertisements. In advertising settings, it is commonly aimed to keep distraction as low as possible, for example by changing the lyrics or by entirely removing them and include a voice-over to communicate the desired message. In auditory health persuasion, it seems also worthwhile to ensure that distraction is low while processing the content information, or at least for some recipients.

Chapter 5

The differential effects of persuasive health information presented through text, audio or a text stream, on the intention-behavior relationship

Abstract

Persuasive health messages can be communicated via different modes, such as the visual or auditory mode. These modes can provide different opportunities for self-regulation of the relevant health information and this may eventually influence persuasion. We investigated the effect of these opportunities on the relationship between intention and behavior. Respondents (N = 128) were exposed to either a textual, auditory or text stream persuasive health message. The latter condition is expected to contain less opportunities for self-regulation compared to the textual and auditory condition. Intention was measured immediately after message exposure; behavior was operationalized as self-reported fruit and vegetable intake two weeks later. Intention and behavior were positively correlated only after exposure to the text stream. In addition, differences between conditions were found in respondents with a low post-test intention; a lower score on behavior was found after the text stream. In the absence of self-regulation opportunities in the text stream, the lower score on behavior may be indicated as a defensive response. The relationship between intention and behavior partly depends on the available sources for defensive self-regulation.

▶ Chapter 5 is based on Elbert, S.P., Dijkstra, A., & Bartels, A. *(submitted).* The differential effects of persuasive health information presented through text, audio, or a text stream, on the intention-behavior relationship.

The differential effects of persuasive health information presented through text, audio, or a text stream, on the intention-behavior relationship

Health messages can be communicated through different modes; at least via the visual mode and via the auditory mode. In the visual mode, the information may be presented as a text (with or without images), such as a tutorial, a flyer or a poster, while in the auditory mode the information may be presented as an auditory fragment, such as a radio commercial or telephone message. Messages as communicated via these two different modalities have different characteristics. For instance, aspects of these communication modes may influence how the information is processed. This may be especially the case when persuasive health information is communicated, which mostly contains information on relevant health outcomes and, therefore, may activate different emotions such as fear (Maloney, Lapinski, & Witte, 2011; Witte, 1992, 1994) and negative self-evaluative emotions (Dijkstra & Buunk, 2008a; van 't Riet & Ruiter, 2013). During the processing of the persuasive health information recipients will have to cope with these emotions through emotion-regulation and self-regulatory strategies that are available to them at that specific moment. In this exploratory study, it is proposed that textual and auditory messages differ in the ways they can provide the opportunity to self-regulate these emotions, which may influence persuasion.

On the one hand, with regard to processing textual health information without time pressure, there is substantial freedom in processing the information as it 'stands still' (Chambliss & Garner, 1996). For example, one can elaborate and determine which part of the text to focus on by using eye movements, scanning the text, skipping certain parts of the text or reading back and forth. In case of processing threatening textual information, these opportunities in attention-allocation can be used to regulate the mental representation of the expected outcomes and the negative (self-evaluative) emotions that are associated with the information (Isaacowitz, 2006; Liberman & Chaiken, 1992; van 't Riet & Ruiter, 2013), for example by avoiding emotion-laden words or passages and selective exposure to more neutral parts of the text.

On the other hand, with regard to the processing of auditory health information, there is less freedom to process the information: While listening to persuasive health information, one is more or less forced to process the information in the sequence and with the speed it is presented, word after word. Instead of having the opportunity to switch between parts of the text or words, one is captured by a stream of words. In addition, an auditory health message more closely resembles the real-life situation of someone talking directly to the recipient, which makes it more immediate and personal, compared to a

text (Jensen, Farnham, Drucker, & Kollock, 2000). Therefore, compared to textual information, the source seems more prominent in auditory information, and the voice and speech of the source can now be used to evaluate the source (Chaiken & Eagly, 1983; Pfau, Holbert, Zubric, Pasha, & Lin, 2000). Indeed, perceived prosodic features of the voice (intonation, speech rate) can be conceptualized as the peripheral or heuristic cues that may play a major role in auditory communication (Gélinas-Chebat, Chebat, & Vaninsky, 1996). These cues are found to be related to source characteristics as well (e.g., Apple, Streeter, & Krauss, 1979; Chebat, El Hedhli, Gélinas-Chebat, & Boivin, 2007). Instead of the opportunities in attention-allocation, these aspects of auditory information can be used to regulate the mental representations of the presented emotion-laden health outcomes and the related negative emotions, for example by dismissing the source in terms of credibility or expertise (Jacks & Cameron, 2003).

Thus, during listening or reading, different "external" sources for self-regulation may be at the recipient's disposal to cope with threatening information and the related negative emotions. It is expected that the use of these "external" sources to self-regulate influences intention formation during the processing of the information. The core expectation in this study is that mode-specific "external" opportunities to self-regulate during the processing of the persuasive information will influence the quality of the intention formation: It will influence whether intention will be the basis for later behavior. When there is the opportunity to self-regulate using the "external" mode-specific means during the processing of a threatening message, it is expected that the formed intention will not be the basis of later behavior. This prediction is based on the fact that the mode-specific opportunities for defensive self-regulation are only available *during* the processing and intention formation, but not when the behavior is executed later; intention and later behavior are generated in different contexts. Therefore, when recipients rely on the "external" opportunities to self-regulate during the processing of the (textual or auditory) information, the intention and the behavior become dissociated. In contrast, when few or no "external" sources for self-regulation are available during processing, intention and later behavior are generated in a more similar context; using "internal" sources only.

The present study

In this exploratory study we test whether the opportunity to self-regulate using "external" sources during the processing of persuasive health information affects the relationship between intention and behavior. This was done by communicating a health message via different communication modalities that are thought to provide different opportunities to self-regulate. Persuasive information presented through the auditory and the textual mode are expected to give ample opportunity to engage in defensive self-

regulation, while these opportunities are diminished when the persuasive information is presented through a text stream. That is, in the text stream condition, respondents are exposed to the same content persuasive information as in the audio and text conditions, but it is offered in meaningful units (a few words) of text that will subsequently appear at a fixed point on the screen for two seconds each. With this, the text stream does not contain: 1) the possibility as in the text condition to strategically use eye-movements and attention-allocation, and; 2) the possibility as in the audio condition to form biased perceptions of the source who is presented by the voice. This implies that in the present exploratory study the use of "internal" sources is defined as: not being able to use "external" sources. Thus, in the present research design the auditory and textual mode are compared to the text stream mode.

The content of the threatening health message was identical in all three conditions. The health message advocated fruit and vegetable intake and it was negatively framed, addressing the disadvantages of eating an insufficient amount of fruit and vegetables. This was done to elicit a certain level of threat and the need for defensive self-regulation. In addition, the auditory message was spoken with a high level of intonation, as previous research with these auditory messages showed that this can elicit a certain level of threat as well, at least in a group of respondents (see Chapter 3).

In the current study, intention is assessed immediately after exposure to the persuasive message, whereas behavior is operationalized as the self-reported fruit and vegetable intake two weeks after being exposed to the health information. The study aimed to explore health behavior change processes within the different communication modalities. Yet, it is initially expected that the strength of the relation between the intention and the behavior would differ between the conditions: The intention-behavior relation would be strongest in the text stream condition as no "external" sources of self-regulation are available. The starting point is to analyze the effects of the interaction between condition and post-test intention on behavior, and to study the correlations between intention and behavior within each condition.

Method

Recruitment and design. This study investigated the influence of the mode of communication (textual health information vs. auditory health information vs. text stream health information) on persuasion in a 1 × 3 between-participants design. The research was conducted in the laboratory of the faculty of Behavioral and Social Sciences among students from the local university. Participants received partial first-year psychology course credits after completing both the lab experiment and an online follow-up questionnaire two weeks later (one respondent participated voluntarily). Respondents were recruited via the online participant pool and the distribution of flyers at first-year psychology courses.

Procedure. Participants were welcomed in the laboratory that consisted of four individual cubicles. They were randomly assigned to one of three experimental conditions in order of registration. Assessments and manipulations were all presented on a computer. After an introduction screen, a screen with informed consent information was presented to the respondents, addressing the confidentiality of the research. In addition, instructions were given. Then, they were presented with the pre-test questions and a filler-task.

Next, respondents were exposed to the health information communicated as a text, as an auditory fragment (spoken by a female speaker) or as a streaming text. When a respondent was exposed to the auditory fragment, a short auditory recording was first presented on volume regulation to ascertain that the level of volume of the actual health message was sufficient and convenient. While listening to this recording, respondents could adjust the volume to their individually preferred level by using volume control buttons integrated in the headphone. The content of the messages referred to the disadvantages of eating insufficient fruit and vegetables. After the manipulation, additional questions were asked, representing intention, process measurements and the manipulation check. In total, the experiment took a maximum of 30 minutes and afterwards participants were asked to write down their e-mail address for receiving the follow-up questionnaire, that assessed the self-reported actual fruit and vegetable intake per week. After completing the final questionnaire online, respondents could indicate whether they were interested in receiving information about the study.

Materials and measures • *Persuasive message.* The presented outcomes in the negatively framed message (242 words) were based on Dijkstra, Rothman, & Pietersma (2011): both negative outcomes to be present (e.g., increased health risks) and positive outcomes to be absent (e.g., reduced physical stamina) when consuming insufficient fruit and vegetables were presented. An increased risk for cancer and for heart diseases were included as two major negative physical outcomes of insufficient fruit and vegetable intake. In addition, insufficient consumption was said to lead to looking unhealthy, to increase aging, and to reduce physical stamina and concentration on mental tasks. Two intermediary negative physical aspects were presented to be related to these consequences: high blood pressure and high levels of cholesterol. Finally, a decreased intake of vitamin C and E was integrated within the text in relation to the presented outcomes.

In case of the textual health information, respondents could read the information as a standard text on one screen without any time limits. In the auditory health information condition, respondents listened to an auditory version of the text (113 seconds). This was recorded in collaboration with a professional recording studio, and a gender-congruent female voice was selected in order to keep the recordings as natural as possible. In addition, it was necessary that the voice did not contain any disturbing

elements, such as an accent. The text was spoken with a high level of intonation to elicit a certain level of threat (see Chapter 3). Respondents could not rewind, forward or pause the auditory fragment. Finally, in case of the text stream, the information was divided in clusters of meaningful words that were presented in the middle of the screen. The text was divided in 74 clusters and most clusters were presented for 2 seconds; when it was a relatively short cluster, the information was presented for 1,5 second. After that, the next cluster appeared on the screen, while the previous one disappeared. In total, it lasted approximately 140 seconds to process the text stream. Respondents could only read it once and they did not have any control over the length of the presentation of the clusters (see Appendix 1b, 1c and 2, QR-code 6 for all three conditions).

• ***Pre-test measures.*** At pre-test, gender and age were assessed as demographic variables. Next, perceived own health status was assessed as the extent to which respondents considered themselves as healthy (CBS, 2013). This item could be answered on a six-point scale ranging from ("my health is…") 'very good' [1] to 'very bad' [6]. The item was recoded to ensure that high scores correspond with good health (M = 5.08, SD = .68). Two items assessed the respondents' value attached to health, referring to "how important" and "how valuable" the own health was for the respondent (r = .57, p < .001, M = 6.32, SD = .59). Both items could be answered on seven-point scales ranging from 'not very important/valuable' [1] to 'very important/valuable' [7]. In addition, respondents were asked to indicate the perceived consumption of fruit and vegetables, respectively. These two items could be answered on a five-point scale ('minimal' [1] / 'few' [2] / 'slightly insufficient' [3] / 'sufficient' [4] / 'more than sufficient' [5]). The item scores were averaged to create a composite measure score of perceived fruit and vegetable consumption (r = .36, p < .001, M = 3.55, SD = .79). Then, intention to start consuming more fruit and vegetables in the next year was assessed with two statements: "I am planning to…within one year" and "It is likely that I…within one year". These items could be answered on seven-point scales ranging from 'absolutely not' / 'not likely at all' [1] to 'absolutely' / 'very likely' [7]. Again, a composite measurement was created (r = .77, p < .001, M = 4.52, SD = 1.36). Finally, questions not pertinent to the study were administered at pre-test. Right before exposure to the health message, respondents completed a scrambled word task as a filler task.

• ***Post-test measures.*** First, questions were asked to check whether the manipulations were received as intended. Attention allocated to the message was measured with two items: 'How well did you manage to keep your attention to the (auditory) message on fruit and vegetables?' and 'How well could you follow what was said?' The questions could be answered on seven-point scales, ranging from 'not at all' [1] to 'very good' [7]. The items were averaged to create a composite measure (r = .72, p < .001, M = 5.82, SD = 1.00). In addition, we assessed how well respondents understood the message with the question: 'How well did you manage to understand the

message?' (M = 6.14, SD = .88). This item could be answered on an identical seven-point scale. Then, several post-test questions not pertinent to the current study were administered.

Next, intention to start consuming more fruit and vegetables was assessed with six questions regarding the planning and likelihood of performing the behavior in one month, six months, and five years respectively (α = .95, M = 5.90, SD = 1.83). To lower the probability of participants answering strategically (remembering their pre-test score), these items could be answered on nine-point scales ranging from 'absolutely not' / 'very unlikely' [1] to 'absolutely' / 'very likely' [9]. Finally, respondents completed a memory task that consisted of a list of 36 words related to fruit and vegetable intake. They were asked to check 12 words they thought were included in the text they were exposed to. A composite measure was created referring to the number of correctly remembered words (M = 8.67, SD = 1.71).

• ***Follow-up measures.*** Exactly two weeks after completion of the experiment, respondents received a follow-up questionnaire as an obligatory part of the study. The questionnaire was a detailed and validated frequency-questionnaire on the own average weekly fruit and vegetable intake regarding the past two weeks (self-reported fruit and vegetable intake; Bogers, van Assema, Kester, Westerterp, & Dagnelie, 2004). Respondents could indicate how often on average they ate or drank products from several fruit and vegetable categories during the previous week. The eight answering options ranged from 'never or less than 1 day a week' [0], '1 day a week' [1] to 'every day' [7]. Next, they were asked to indicate the amount of intake per category of fruit or vegetables in terms of pieces of fruit and servings of vegetables (six answering options, ranging from 'no pieces / glasses / serving spoons' to 'five or more pieces / glasses / serving spoons'). The main categories were 'cooked vegetables', 'raw vegetables / salad', 'fruit / vegetable juice', 'tangerines', 'oranges / grapefruits / lemons', 'apples / pears', 'bananas', 'other fruit' and 'apple sauce'. The average number of days per week and the pieces of fruit and vegetable portions (defined as 50 grams each) were multiplied for each category and added to create a composite index of weekly fruit and vegetable intake (a score of 42 is classified as sufficient; scale ranging from 5 to 81; M = 38.9, SD = 16.4).

Results

Participants and randomization check. In total, 136 respondents participated in the laboratory study. Three participants were excluded as they had participated in prior research using the same auditory text on fruit and vegetable consumption. Five respondents did not complete the follow-up questionnaire. Therefore, the final sample consisted of 128 participants, of whom 107 females (84%), ranging from 17 to 43 years old (M = 19.2, SD = 2.6). They were distributed over the conditions as follows: Visual information (n = 42); auditory information (n = 43); text stream information (n = 43)[1].

Univariate analyses were conducted to analyze whether the conditions differed on relevant pre-test measures. No significant differences were found regarding the distribution of gender ($\chi^2(2) = 2.24$, $p = .33$), age ($p = .14$), pre-test intention ($p = .99$), perceived fruit and vegetable consumption ($p = .07$) and perceived own health status ($p = .16$). All analyses regarding behavior were performed while controlling for the latter three variables as these are conceptually related to the reception of health messages.

Attrition analyses and manipulation check. It was analyzed whether respondents who did not complete the study ($n = 5$) differed from the respondents who did. They did not differ significantly at the pre-test variables as mentioned above, $ps > .16$. In addition, condition did not significantly affect whether or not respondents completed the study, $p = .81$.

No significant difference was found between the three conditions regarding our composite measurement of attentional processes; $F(2, 125) < 1$, $p = .59$, or on the separate items. In addition, no significant difference was found regarding understanding; $F(2, 125) < 1$, $p = .69$. Thus, the different communication modalities did not lead to differences in attention allocated to the message or the extent to which the message was understood.

Effects on process measurements. A marginally significant main effect of condition on the memory task was found; $F(2, 125) = 2.78$, $p = .066$, $\eta_p^2 = .04$. The means show that after listening to the auditory message, more words were remembered ($M = 9.17$, $SD = 1.62$) compared to the textual message or the text stream message ($M = 8.35$, $SD = 1.69$; $M = 8.51$, $SD = 1.75$, respectively). The contrast between the auditory and textual message was significant ($p = .027$); between the auditory and text stream message it was marginally significant ($p = .076$), and between the textual and text stream message it was not significant ($p = .66$).

The relationship between intention and behavior[2]. First, it was analyzed whether condition had an effect on fruit and vegetable intake as reported two weeks later, and whether there was an interaction with post-test intention. Pre-test intention, perceived own health status and perceived fruit and vegetable consumption were standardized and included as covariates. No significant main effect of condition was found on fruit and vegetable intake; $F(2, 122) < 1$, $p = .67$, $\eta_p^2 = .01$. In all three conditions, the mean

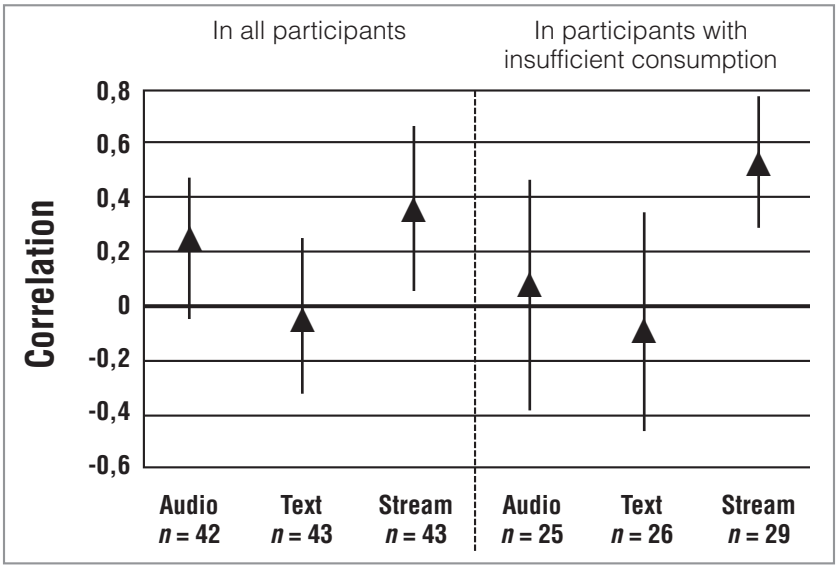
[1] Four respondents had a non-Dutch cultural background. When we conducted the interaction between condition and post-test intention on behavior without these respondents, the interaction became non-significant ($p = .11$, $\eta_p^2 = .04$). However, the pattern of results in terms of correlations was similar and only small changes in p- and F-values were found.

[2] The effects on behavior were of primary interest to us. However, we also found an effect on the intention to start consuming more fruit and vegetables as assessed at the immediate post-test, a short-term measure of persuasion. Again, the same three covariates were added. The main effect of condition on intention was not significant ($F(2, 122) < 1$, $p = .84$, $\eta_p^2 = .00$, but the interaction between condition and health value (a measure of involvement) was significant; $F(2, 119) = 3.84$, $p < .05$, $\eta_p^2 = .06$. Recipients with high health value did not show differences between the conditions, but recipients with a moderate health value reported a marginally significant lower intention after being exposed to the auditory message, compared to the textual ($p = .051$) and the text stream message ($p = .10$).

fruit and vegetable intake scores were relatively high; auditory health message (M = 39.25, SE = 2.23); textual health message (M = 40.09, SE = 2.21); text stream health message (M = 37.27, SE = 2.25). No significant contrasts were present.

However, a significant interaction between post-test intention and condition was found; $F(2, 119) = 3.30$, $p < .05$, $\eta_p^2 = .05$. To further examine the meaning of this effect on fruit and vegetable consumption, partial correlations between intention and behavior were computed within each condition (again controlled for standardized measures of pre-test intention, perceived own health status and perceived fruit and vegetable intake at pre-test; see Figure 5.1, left panel). Overall, this correlation was marginally significant (r = .16 , p = .07, *CI* ranging from .01 to .32). In addition, in the text stream condition, this correlation was significant (r = .37; p = .018; CI .06 to .64) . This was not the case in the audio condition (r = .23; p = .16; CI -.04 to .46) and the textual condition (r = -.03; p = .84; CI -.30 to .23).

Figure 5.1 The correlations between post-test intention and behavior within the three different communication modalities ▼



Note. The correlations are controlled for pre-test intention, perceived own health status and perceived fruit and vegetable intake at pre-test. Left panel: the correlations as computed in all respondents. Right panel: the correlations in respondents who indicated awareness of at least consuming insufficient fruit or vegetables.

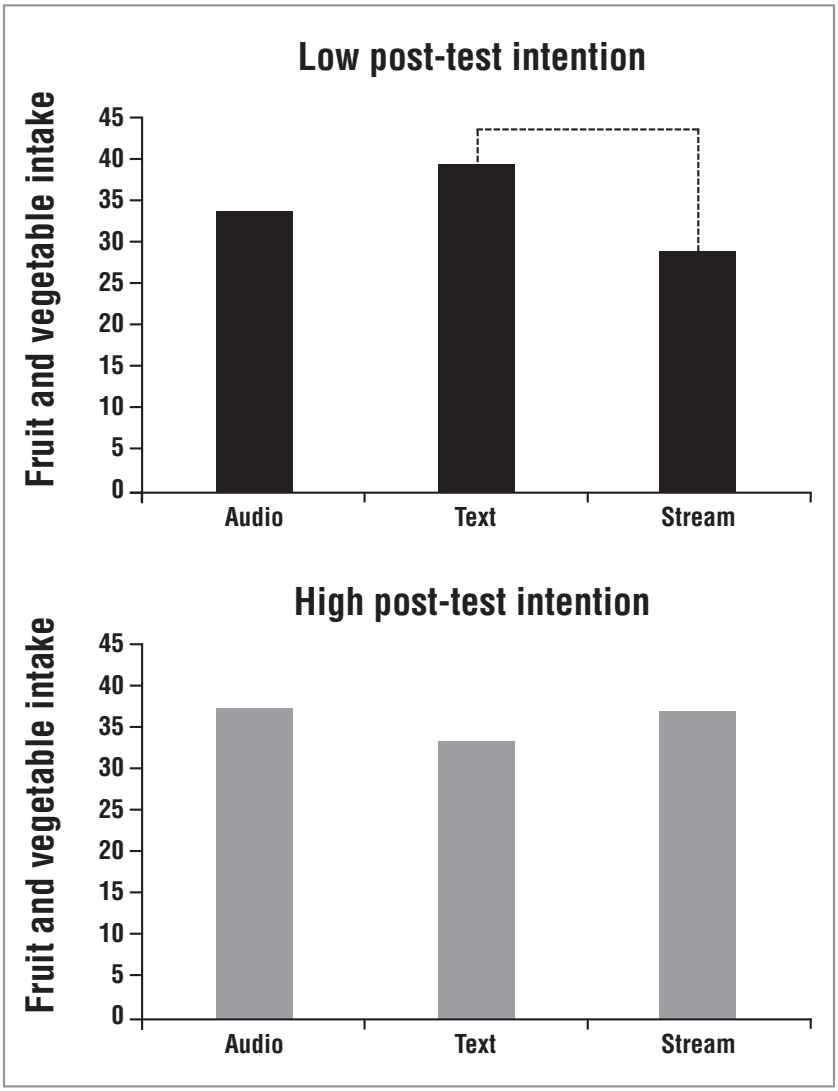
In the present theorizing, defensive self-regulation is only needed when recipients experience negative emotions in reaction to the message. However, our sample also included people who had indicated at pre-test to perceive their fruit consumption and / or their vegetable consumption as 'sufficient' or 'more than sufficient' (scoring a 4 or 5 on the 5-point scale). Therefore, in a further analysis we selected only those who scored lower than 'sufficient' on fruit consumption and / or vegetable consumption, meaning that at least on one of these measures recipients indicated awareness that the own consumption was not sufficient (n = 80). The interaction between post-test intention and condition was still significant; $F(2, 68) = 3.57$, $p < .05$, $\eta_p^2 = .10$. Looking at the correlations between post-test intention and later behavior in the conditions, the correlation was significant in the text stream condition, $r = .54$; $p < .01$; CI .27 to .78. This was not the case in the audio condition ($r = .07$; $p = .76$; CI -.39 to .45) and the textual condition ($r = -.10$; $p = .65$; CI -.42 to .31; see Figure 5.1, right panel). The correlation between intention and behavior in the whole sample was .14 ($p = .23$, CI ranging from -.04 to .33).

The above differences between the conditions might be related to differences in the variance in post-test intentions. For example, when intentions are formed in the function of defensive self-regulation, intentions may all be high(er) and the variance would be restricted. The means and standard deviations (SD) with regard to post-test intention in the three conditions were: audio 5.82 (1.82); text 5.90 (1.82); and text stream 6.0 (1.88). Firstly, an ANCOVA showed that the main effect of condition on post-test intention was not significant ($p = .84$). Secondly, Levene's test for homogeneity was not significant ($p = .84$), indicating that the variance in the conditions did not differ significantly.

Another way to address the variance issue is to check the relations between the pre- and post-test intentions in the three conditions. That is, the "spontaneous" variance in pre-test intention may be influenced differentially in the three conditions, leading to different relations between pre-and post-test intentions. However, the correlations (r) in the three conditions were quite similar: audio .79; text .70; and text stream .81. An ANOVA revealed that the interaction between condition and pre-test intention in a model with post-test intention as dependent variable was far from significant ($p = .90$), suggesting that these correlations do not differ significantly between conditions.

Condition differences. To further examine the meaning of the interaction effect on fruit and vegetable consumption, the differences between conditions were inspected as well. Simple main analyses were conducted at two different levels (low / high) of the moderator (post-test intention). The complete dataset was used to model respondents as scoring high or low, by adding and subtracting one standard deviation to the standardized means, respectively (Cohen, Cohen, West, & Aiken, 2003). Figure 5.2 displays the means in the conditions for people with low and high post-test intention.

Figure 5.2 The effect of condition for people with a low and a high post-test intention on self-reported fruit and vegetable intake ▼



When post-test intention was high, there was no significant effect of condition on self-reported behavior two weeks later ($p = .46$). The means were relatively high: Auditory message: $M = 44.61$; textual message: $M = 39.62$; text stream message: $M = 44.10$. No significant contrasts were present. When post-test intention was low, the effect of condition was marginally significant; $F(2, 119) = 3.03$, $p = .052$, $\eta_p^2 = .05$. The means were as follows: Auditory message: $M = 34.48$; textual message: $M = 40.33$; text stream

message: M = 29.36. The only significant contrast was between the textual and text stream health message (p = .016). Thus, respondents who initially had a low intention immediately after being exposed to the message, reported a higher fruit and vegetable intake two weeks later when they were exposed to the textual message, compared to respondents who were exposed to the text stream message. Thus, in the text stream condition, when participants had a low immediate post-test intention, their fruit and vegetable intake two weeks later was also lower.

The results in the subsample with "insufficient" scores on fruit and/or vegetable intake were very similar: When post-test intention was low, the effect of condition was still marginally significant; $F(2, 68) = 3.57$, $p = .051$, $\eta_p^2 = .08$, with the contrast still being significant.

Discussion

In the current study we investigated the influence of the availability of self-regulation opportunities on persuasion processes. The availability was manipulated using three communication modalities through which a threatening health message was communicated (text, audio, text stream). In line with the expectations, a significant relationship between intention (immediately assessed after being exposed to the threatening information) and behavior (assessed two weeks later) was only present after being exposed to the text stream, which is characterized by a diminished opportunity to engage in defensive self-regulation. In a selective sample of participants who reported to eat an insufficient amount of fruit or vegetables, and therefore, can be expected to experiences stronger negative emotions (such as fear) after exposure to the message and stronger defensive self-regulation, the correlation was even higher (.54) compared to when all respondents were included in the analysis. This magnitude is similar to that found in the meta-analysis of Sheeran (2002). In addition, the effect size η_p^2 of the interaction between post-test intention and condition on behavior was also larger (.10). At this point, it might be concluded that as far as the three communication modalities indeed differed primarily in the possibilities to engage in defensive self-regulation, this seems to have affected the relation between intention and behavior.

Besides the correlations between intention and behavior, the interaction effect of condition and the immediate intention on later behavior may help understand what happened: When the post-test intentions were high, there were no differences between the conditions on behavior. When the post-intentions were low, only the behavior in the text stream condition was significantly lowered. In other words, the low intentions in the audio and text conditions did not mean anything for later behavior: Despite low intentions, participants still engaged in the behavior. The findings suggest that only in the text stream condition the low intention was translated into an accordingly low engagement in the behavior.

As proposed in the introduction, in the textual and the audio conditions participants were supposed to have "external" sources to self-regulate available to them during the processing of the threatening information and the intention formation, such as avoiding the information with visual attention allocation or downgrading the source of the message. It is assumed that these sources are not available at the moment that later behavior is generated when participants are at home or at the supermarket. In that, the intention and the behavior are generated under different conditions. In contrast, in the stream condition fewer or no "external" sources to self-regulate were available during the processing and the intention formation: Recipients had to handle the threatening information "by themselves", using "internal" resources. This may mimic more closely the situation under which later behavior is generated. Now the intention and behavior are generated under more similar conditions. This explanation introduces "contextual self-regulation": The effect of the availability of contextual factors that can be used to self-regulate.

A complementary angle to understand the findings starts by focusing on the low post-test intention; we might assume that this low intention indicates a defensive reaction (Epton & Harris, 2008; Harris & Napper, 2005; Liberman & Chaiken, 1992; Reed & Aspinwall, 1998; van Koningsbruggen, Das, & Roskos-Ewoldsen, 2009; van 't Riet & Ruiter, 2013). As mentioned above, the results show that only in the stream condition this defensive reaction (as indicated by the low intention after exposure) was translated into low engagement in the behavior, suggesting a lasting and encompassing defensive reaction. In contrast, in the audio and text conditions the defensive reaction may have been temporary, leaving room for recovery from the defensive reaction and the independent occurrence of later behavior. In other words, because participants in the audio and text conditions could satisfactorily self-regulate their emotions using the provided "external" opportunities, they did not need to use a "next level", deeper defense to cope with the threatening information.

This reasoning implies that there is not one simple way people use to regulate their negative emotions but that defensive self-regulation may be accomplished in different ways on different levels (e.g., Jacks & Cameron, 2003; van 't Riet & Ruiter, 2013). Future studies should try to replicate the present findings, and apply process measurements to test the above explanations.

Importantly, the data showed no significant differences in post-test intentions between the conditions, no significant differences in the variance of post-test intentions between conditions, and no significant differences in the correlation between pre-test and post-test intentions between the conditions. This suggests that the lack of a relation between this intention and later behavior in the audio and text conditions was not caused by extreme (higher or lower) scoring or otherwise restricted variances. Thus, the effects of the messages seem not to be caused by effects on intentions, but specifically by effects on the link between intention and later behavior.

In addition to these findings related to our central hypothesis, it was found that people who listened to the auditory message remembered significantly more words (recognition) compared to respondents who read the textual message. Although earlier research found mixed results for the effect of communication mode on the recall of health-related information (e.g., Corston & Colman, 1997), we think it can be partly explained here by the salience of the auditory message: Respondents may have experienced the auditory message as more direct, more personal and self-referencing (Chaiken & Eagly, 1983; Jensen et al., 2000; Symons & Johnson, 1997). In addition, the auditory message contained peripheral cues such as voice characteristics that are not available while processing textual information and the message was spoken with a high level of intonation, which might have resulted in a more vivid mental representation of the outcomes of the message (see also Chapter 3). These auditory aspects may have consequently led to better storage of the information in the long term memory. However, these intermediate processes were not taken into account in the current study. At least, the effect on recognition seemed not to have been driven by a motivational component, as the value attached to the own health did not have any effect on how many words were remembered. Furthermore, it is found that the conditions did not differ on measures of attention or understanding. It may be that the defensive self-regulatory processes do not necessarily entail memory processes.

The current study has some relevant limitations. One major shortcoming of the present study is that it is unknown what exactly happened during the processing of the persuasive information: Did the participants in the text condition make defensive eye movements?; Did the participants in the audio condition make defensive inferences about the voice and the source?; Did the participants in the text stream condition attend to all presented words (or meaningful units)? Because we did not assess these intermediate processes, there remains uncertainty about what exactly was manipulated, and how the effects on the intention-behavior relationship were brought about. In addition, perceived comprehension of the message was assessed, but this may not be similar to actual comprehension as both can vary significantly within recipients (e.g., Jansen & Janssen, 2010). Another limitation is that it is unknown why a part of the participants had a low intention at post-test. We assume that this is part of a defensive reaction (Liberman & Chaiken, 1992; van 't Riet & Ruiter, 2013) but this is not investigated. Another limitation is that fruit and vegetable intake was not measured at pre-test. Instead, only the extent to which respondents perceived their consumption as sufficient or not was taken into account. However, the randomization of other health-related variables seemed to have been successful, and when it comes to reactions towards a persuasive message concerning fruit and vegetable consumption, it is argued that this reaction will be more strongly based on the perception of the own behavior than on the behavior itself.

The present study contributes to our understanding of the persuasive process. Firstly, as a main effect of communication modality on behavior could not be reported, it does not seem to make a difference whether the auditory, textual or stream mode is used when it comes to the practice of persuasion, at least for short-term behavior change (i.e., 2 weeks). It was found that most people might benefit from textual and auditory health information, and it may not hurt to have access to some "external" self-regulatory strategies at the specific moment of message exposure to prevent more encompassing defensive reactions. Secondly, this study adds to our understanding of the intention-behavior gap: It provides a novel angle to this issue in which the relation is influenced *during* the processing of relevant persuasive information, and depends on the available sources for defensive self-regulation. Thirdly, the study signals that we need a more elaborate perspective on defensive self-regulation: What defensive mechanisms do people have at their disposal, and when are these different mechanism mobilized? Lastly, this study contributes to our understanding of the different modes that can be used to persuade people: By construing the modes not only as pathways of delivery of the persuasive information, but also as providing recipients with different opportunities for self-regulation, new insights are generated on the modes and optimal application of modes. All in all, we hope to inspire more research on the above topics and contribute to a better understanding of the process of persuasion.

Chapter 6

Health information told by various sources in auditory health persuasion: The potential moderating effect of personal involvement

Abstract

One central choice in the development of a comprehensive web-based health intervention aimed at increasing fruit and vegetable intake concerns the source of the auditory information: Should it be communicated by a physician, a nutrition scientist, an employee of the nutrition center, or a member of the target group? To be able to make decisions concerning the need for and the type of the source to be presented, an experiment was conducted. University students (N = 147) listened to a brief auditory message in which a female voice advocated fruit and vegetable consumption. Right before the persuasive message, the source introduced herself by mentioning her name and profession. Four source conditions were formed and one condition did not include a source introduction. Dependent variables were the intention to eat more fruit and vegetables as assessed immediately, and fruit and vegetable consumption reported after two weeks. The results showed no main effects of condition on both dependent variables. Individual pre-test differences in the value attached to health significantly moderated the effects of the source on fruit and vegetable consumption. These results help to make an evidence-based choice in our web-based intervention: It seems it is most rational not to mention a particular source.

▶ Chapter 6 is based on Elbert, S.P., & Dijkstra, A. *(submitted)*. Health information told by various sources in auditory health persuasion: The potential moderating effect of personal involvement.

Health information told by various sources in auditory health persuasion: The potential moderating effect of personal involvement

The present study is conducted in the framework of the development of a comprehensive web-based tailored health behavior change intervention. This composed intervention will be offered as a smartphone application that will communicate health information via the auditory mode to stimulate fruit and vegetable consumption.

To develop effective interventions it is important to systematically build the content on the basis of scientific evidence, as much as possible. Therefore, the use of intervention development protocols such as Intervention Mapping (Bartholomew, Parcel, & Kok, 1998; Kok, Schaalma, Ruiter, van Empelen, & Brug, 2004) and the PATH-model (Dijkstra & Buunk, 2008b) is necessary. In these protocols effective methods need to be chosen and the conditions under which they are applied need to be set before implementing the intervention.

In the smartphone intervention that is currently under development, the persuasive information is shaped using two methods, argumentation and framing. This information will be provided through the auditory channel: A person - the messenger - will tell the persuasive message and the recipient will only hear a voice telling the persuasive message. One condition under which these methods may be effective in auditory persuasion is the source of the message. That is, it can be expected that perceptions of the source of persuasive information may inhibit or support the effects of the content persuasive information. The present experiment is designed to explore the effects of source on persuasion, with the aim to contribute to the evidence-based development of the smartphone intervention.

As mentioned above, in the smartphone intervention, and, therefore, also in the present experiment, the persuasive information will be communicated through the auditory channel. New technological developments facilitate the use of auditory channels in general and within the development of online health interventions as well. In particular, MP3 is a technological advancement broadly disseminated in modern society and used by millions of people. As it is included in easy portable MP3-players and mobile phones, the potential value and reach of MP3 as a channel of auditory information is enormous, the use of auditory files in apps included.

Listening to a message may enhance the salience of speaker information, which in turn might impact persuasion (Chaiken & Eagly, 1983). Compared to written information, in auditory information the source is more salient and recipients have a lively cue to develop a mental representation of the source. In this auditory intervention it is about the

owner of the voice that is heard; the persuasiveness of the message might depend on who is telling the message. From persuasion research findings we know that the source of a message may influence the persuasiveness of the message (Briñol & Petty, 2009; Petty & Cacioppo, 1984; Wilson & Sherrell, 1993; Hu & Sundar, 2010). Therefore, the practical question that needs to be answered to develop our smartphone intervention is: "What is the most effective way of presenting the identity of the messenger?" The present study is about answering this question. Particularly, it will be tested how the messenger should present herself, for example: "My name is Marieke van Dijk and I am a *physician*" or "My name is Marieke van Dijk and I am a *student*". Findings on the persuasive effect of source introductions in health messages may be practically relevant for health education purposes and the development of lifestyle interventions.

Research shows that persuasion can be affected by qualities of the source of the message (Briñol & Petty, 2009). For example, a health message can be more or less effective if knowledge on the expertise of the source is available (Wilson & Sherrell, 1993). In the unimodel of persuasion (Kruglanski & Thompson, 1999), all message cues (both the actual content and source information) serve as evidence that can possibly lead to persuasion. Moreover, dual-pathway models of persuasion, such as the elaboration likelihood model (ELM; Petty & Cacioppo, 1986; Petty & Briñol, 2012) and the heuristic systematic model (HSM: Chaiken, Liberman, & Eagly, 1989) specify that there are two distinct routes to persuasion. Both listening to the content persuasive information (central or systematic information processing) and the peripheral cues (information on the source expertise, related to heuristics such as "The speaker is an expert, so it must be true") might influence persuasion. Heuristic processing may affect persuasion by its own, but it can also influence the systematic processing of the information (Chaiken & Maheswaran, 1994). For example, listening to health information provided by a physician may positively bias systematic information processing when the source is perceived as credible, especially compared to when the health information is provided by a carpenter. The peripheral cue under study refers to the source presentation that might influence source perceptions and, subsequently, persuasion.

However, explicitly presenting the source may not be relevant for all recipients; individual differences may be relevant. Therefore, we aimed to investigate in whom mentioning a specific source is particularly effective or not. In the development of a smartphone intervention, computer-tailoring can be applied to take into account differences between individual smartphone users (Dijkstra, 2008; Lustria, Cortese, Noar, & Glueckauf, 2009). This makes it possible to adapt specific aspects of persuasive messages to individual recipients, also in auditory forms of tailoring (Brakel, Dijkstra, Buunk, & Siero, 2012).

One specific individual difference will be taken into account. In the domain of health, the extent to which individuals value their health may be a relevant individual

difference when it comes to persuasion. This variable can be considered a measure of value involvement (Eagly, 2007; Johnson & Eagly, 1989). There is strong evidence that people who differ in personal involvement in the topic of persuasion respond differently to source information (Chaiken et al., 1989; Petty & Cacioppo, 1986; Petty & Briñol, 2012; Wilson & Sherrell, 1993). For example, people who highly value their health might invest more effort in processing all types of information (whether central or peripheral; Homer & Kahle, 1990). As most people value health, we distinguish between people who value health as top priority in their lives (high health value) and people who acknowledge that health is important, but not the most important value in life (moderate health value; Dijkstra & van Asten, 2014; Pietersma & Dijkstra, 2011). The difference between recipients who moderately or highly value health, lies in the level of threat that is induced by the persuasive message and how they handle the threat.

Persuasive health messages typically are threatening as they present negative outcomes of unhealthy behavior or missing positive outcomes of healthy behavior. Most people will experience this threat but, additionally, the source of the information may influence the level of threat. However, this depends on the extent to which the information on the source is processed. Recipients who view health as top priority are expected to be less affected by the source introductions: For them, it does not matter who is communicating the information, they will focus on the content information that corresponds with their top priority. In contrast, moderately involved recipients are expected to be influenced by the source introduction: They may perceive differences between the sources and related levels of threat. For instance, for these people, a physician as source might lead to the highest threat because of its association with and authority regarding illness. These differences in source perceptions and levels of threat may transfer into differences in persuasion.

In line with this, earlier studies showed that participants with moderate health value react with defensive self-regulation when they are exposed to a threatening message, as suggested by lowered persuasion (Dijkstra & van Asten, 2014; Pietersma & Dijkstra, 2011). Thus, it seems that people who moderately value their health do acknowledge the threat but are not ready to change their behavior accordingly and will engage in fear control processes (Leventhal, 1971; Maloney, Lapinski, & Witte, 2011). In contrast, the same studies also show that people with high health value are able to translate the threat into action; they are persuaded. For these people the threatening information is in line with their top-priority and they use it to adhere to their value (and engage in danger control processes instead).

In the current experimental study, the source introduces herself with one short sentence prior to the health message itself (e.g., 'My name is … and I am a physician'). The persuasive effects of different source introductions will be assessed immediately after the persuasive message with a measure of intention (to increase fruit and vegetable

intake), and with a validated behavioral self-report measure of fruit and vegetable intake two weeks later. Individual differences in valuing health will be assessed at pre-test, to be tested as a moderator. Because this study was conducted in the framework of developing the smartphone intervention, merely sources were studied that could be actually used in the intervention: Three possible expert sources were tested; a physician, a nutrition scientist, and an employee of the Dutch nutrition center, and one source representing the target population; in this study university students. The first research question is: "Which source is the most persuasive (and for whom) and should consequently be used in the smartphone intervention?" A "no-source introduction" was added as a control condition to answer the second research question: "Is it necessary to introduce the source in the smartphone intervention?" Answering these exploratory questions will help to develop an effective intervention based on evidence.

Method

Recruitment and design. The between-participants design consisted of five conditions: Four experimental conditions in which the source introduced herself either as a physician, a nutrition scientist, an employee of the Dutch nutrition center or a college student. In the fifth condition, the no-source condition, the source did not introduce herself. The experiment took place in the laboratory of the faculty of Behavioral and Social Sciences among students from the University of Groningen and the Hanze University Groningen. Respondents were told that they would participate in a study including a fragment of a lifestyle radio-program and a number of questionnaires about communication and lifestyle. They received either partial course credit or a monetary compensation (€ 5).

Procedure. Respondents were welcomed and allocated to one of four individual cubicles in the laboratory. They were assigned to one of the five conditions in order of the arrival in the laboratory. The manipulation (the health message varying in terms of source introduction) and the assessments were all presented on a computer. After an introduction screen, a screen with informed consent information was presented to the respondents, addressing confidentiality and the duration of the study (<20 minutes). Then, they were presented with the pre-test questions. Next, to ascertain that the volume of the actual auditory health message was sufficient and convenient, an auditory recording was presented on volume regulation. While listening to this instructive recording, participants could adjust the volume to their individually preferred level by using volume control buttons integrated in the headphone. Subsequently they listened to a female speaker communicating the persuasive health message, after which additional questions were asked representing the dependent variables. Finally, participants could indicate their willingness to voluntarily complete an online follow-up questionnaire two weeks later.

Materials and measures • *The health message.* The auditory health message itself was recorded in collaboration with a professional recording studio, and spoken by a woman that was selected because of her neutral sounding voice and speech. Furthermore, it was our intention to select a voice that was gender congruent; that is, a high-pitched and feminine voice. The professional actress was instructed to use her voice as normal and natural as possible, as if it would be broadcasted as "an item in a radio program" (see Appendix 1d for the transcript).

The no-source control condition was recorded as a default health message, consisting of 302 words, lasting 125 seconds. The content of the persuasive message was based on Dijkstra, Rothman, & Pietersma (2011), referring to both positive outcomes of eating sufficient fruit and vegetables (e.g., improved physical stamina, decreased risk for cancer and heart diseases), and negative outcomes of eating an insufficient amount of fruit and vegetables (e.g., skin and hair looks unhealthier, not enough anti-oxidants).

The fundamental difference between the four source conditions concerned the self-introduction of the speaker with a name and profession (4 seconds on average) that was inserted right before the above mentioned default health message. The speaker introduced herself with her name and profession, for example, "my name is Marieke van Dijk and I am a physician" or "my name is Marieke van Dijk and I work at the Dutch nutrition center" (see Appendix 2, QR-code 7).

• *Pre-test measures.* The first part of the questionnaire assessed socio-demographic variables, such as gender and age. The next screen assessed the intention to increase fruit and vegetable consumption: "I am planning to start eating more fruit and vegetables within a year". It could be answered on a five-point scale ranging from 'absolutely not' [1] to 'absolutely' [5] (M = 3.46, SD = .96).

Subsequently, three questions regarding the respondent's perceived health value were asked. The first and the second item respectively referred to "how important" and "how valuable" the own health was for the respondent, and could be answered on a five-point scale ranging from 'not very important / valuable' [1] to 'very important / valuable' [5]. The third question stated that health is "the most important thing to me" and could be answered on a five-point scale ranging from 'totally disagree' [1] to 'totally agree' [5]. A composite measurement of involvement was created by averaging the three items (α = .75, M = 4.29, SD = .58).

Two questions assessed the perceived consumption of fruit and vegetables, respectively. These questions could be answered on a five-point scale ('very little' [1] / 'little' [2] / 'slightly insufficient' [3] / 'sufficient' [4] / 'more than sufficient' [5]). Both questions were averaged to create a composite measure of perceived fruit and vegetable intake (r = .23, p < .01, M = 3.32, SD = .82). Finally, some other questionnaires not pertinent to the current study were administered.

• ***Post-test measures.*** Three questions assessed the respondent's intention to increase fruit and vegetable intake within three different time intervals: 'I am planning to start eating more fruit and vegetables…''within one month', 'within six months' and 'within five years'. The three time intervals could each be scored on a seven-point scale, ranging from 'absolutely not' [1] to 'absolutely' [7] and were averaged to create a composite measure (α = .93, *M* = 4.92, *SD* = 1.44).

Perceived source similarity and expertise were assessed as part of the manipulation check. The questions were: 'To what extent do you think the speaker is similar to you?' and 'To what extent do you think the speaker has expertise?' The questions could be answered on seven-point scales with item-specific endpoints, respectively ranging from 'not at all similar' [1] to 'very similar' [7] (*M* = 3.82, *SD* = 1.34), and from 'not at all knowledgeable' [1] to 'very knowledgeable' [7] (*M* = 5.12, *SD* = 1.38).

In addition, we assessed additional source characteristics in the four experimental conditions only. One question assessed whether the person was a typical example of the proposed source (e.g., a physician): 'To what extent do you think of this person as a typical [source]?' The perceived authenticity of the person (the likelihood that the person was indeed who she claimed to be) was measured with the statement: 'It is likely that the speaker is a [source]'. Both questions could be answered on seven-point scales ranging from 'not at all' [1] to 'very strong / very likely' [7].

Finally, respondents could indicate whether they were willing to fill in a follow-up questionnaire. If so, they received an e-mail with a link to an online questionnaire two weeks after completing the experiment. This was a detailed and validated questionnaire about their fruit and vegetable intake (Bogers, van Assema, Kester, Westerterp, & Dagnelie, 2004). Respondents were asked how often on average per week they ate or drank products from several fruit and vegetable categories during the previous two weeks. The answer options ranged from 'never or less than 1 day a week' [0], '1 day a week' [1] to 'every day' [7]. Next, they were asked to indicate the amount of intake per category of fruit or vegetables in terms of pieces of fruit and servings of vegetables. The main categories were 'cooked vegetables', 'raw vegetables / salad', 'fruit / vegetable juice', 'tangerines', 'oranges / grapefruits / lemons', 'apples / pears', 'bananas', 'other fruit' and 'apple sauce'. If the respondent did not answer the question regarding the amount of intake it was treated as a missing variable, except when the previous answer was 'never or less than 1 day a week' [0]; then, the amount of intake was set at zero as well. The average number of days per week and the fruit and vegetables portions were multiplied for each category and added to create a composite index of weekly fruit and vegetable intake (scale scores ranging from 9 to 77; *M* = 37.6, *SD* = 14.4).

Statistical analyses. To check the manipulations, one-way analysis of variance (ANOVA) were used to analyze how the sources in the conditions differed from each

other on perceived similarity, expertise, typicality, and authenticity. The main analyses consisted of ANCOVAs with condition as independent variable, and as dependent variables immediate post-test intention and self-reported fruit and vegetable intake two weeks later, respectively. Pre-test intention and perceived consumption of fruit and vegetables were standardized and included as covariates, as these variables are conceptually related to the reception of health messages on fruit and vegetable intake. To test the moderating effect of health value, the condition × health value interaction was tested with the same dependent variables and covariates. To explore interaction effects, simple main analyses were conducted at two different levels (low/high) of the moderator. To this purpose, the complete dataset was used to model participants as scoring high or low, by adding and subtracting one standard deviation to the standardized means, respectively (Cohen, Cohen, West, & Aiken, 2003). Also in the case of non-significant interactions, the pattern of results and potential significant contrasts between conditions were explored, as this might be of practical relevance for the development of the smartphone intervention.

Results

Participants and randomization checks. In total, 163 respondents participated in this laboratory study. Respondents were excluded from the study when Dutch was not their native language (n = 9), when their participation was interrupted (e.g., by a telephone call; n = 2) or when they reported hearing problems (n = 2). One respondent reported technical difficulties during the study, one respondent was graduated in psychology and one respondent participated in prior research using the same auditory text on fruit and vegetable consumption; they were excluded as well. The final sample consisted of 147 participants (120 women, 82%), varying in age from 17 to 27 years (M = 19.8, SD = 2.06), randomly distributed over the conditions: Physician-as-source (n = 30); scientist-as-source (n = 31); nutrition center employee-as-source (n = 28); student-as-source (n = 29); no-source condition (n = 29).

Univariate and χ-square analyses were conducted to analyze whether the conditions differed on the pre-test measures gender, age, pre-test intention, perceived fruit and vegetable consumption and health value. The conditions only differed significantly on pre-test intention, $F(4, 142) = 3.03$, $p < .05$: it was included as a covariate in all analyses on intention and behavior.

Manipulation checks. The sources did not differ significantly on perceived similarity ($p = .99$), but significant differences were found on perceived source expertise; $F(4, 142) = 3.89$, $p < .01$, $\eta_p^2 = .10$. The physician, the scientist and the nutrition center employee were perceived as significantly more knowledgeable (M = 5.33, SD = 1.35, M = 5.71, SD = .94 and M = 5.25, SD = 1.67, respectively) compared to when the source did not introduce herself (no-source condition; M = 4.55, SD = 1.48, contrasts $p < .05$).

In addition, the physician and the scientist were perceived as significantly more knowledgeable than the student (M = 4.69, SD = 1.11; contrasts p = .064 and p < .01, respectively). Thus, the sources differed on a dimension related to persuasion (i.e., source expertise).

With regard to typicality of the source, significant differences between the experimental conditions were found; $F(3, 114) = 27.12$, $p < .001$, $\eta_p^2 = .42$: The nutrition center employee was perceived as the most typical (M = 5.21, SD = 1.23) compared to all conditions, contrasts $p < .01$. The physician and the scientist were considered similarly typical (M = 4.13, SD = 1.50 and M = 4.10, SD = 1.38), which was significantly more typical than the student source (M = 2.17, SD = 1.04; contrasts $p < .001$). The same pattern was found for perceived authenticity; $F(3, 114) = 9.74$, $p < .001$, $\eta_p^2 = .20$. All in all, the sources differ on the extent to which the voice and/or the role of providing persuasive information fits the participant's expectations.

Effects on intention. First, it was tested whether condition had a significant effect on the intention to increase fruit and vegetable intake. No significant main effect of condition was found, $F(4, 140) = 1.00$, p = .41. In all conditions the intention scores were above the scale midpoint of 4: physician-as-source: M = 4.70, SE = .17; scientist-as-source: M = 5.04, SE = .17; nutrition center employee-as-source: M = 4.86, SE = .18; student-as-source: M = 4.86, SE = .18; no-source condition: M = 5.14, SE = .17. No significant contrasts were present, but the mean score in the no-source condition was the highest and marginally significantly higher compared to the physician-as-source condition (p = .075).

Second, the interaction between condition and health value on intention was tested: It was not significant; $F(4, 135) = 1.32$, p = .27, $\eta_p^2 = .04$. To explore the patterns of means in the conditions within the two levels of health value, post-hoc contrasts were computed. When health value was moderate, there was no significant effect of condition (p = .51), and no significant contrasts could be reported. When health value was high, the effect of condition was also not significant (p = .12), but the intention in the scientist-as-source (M = 5.27) and the no-source condition (M = 5.25) were higher compared to both the student-as-source (M = 4.51; $p < .05$ and $p < .10$, respectively) and the physician-as-source (M = 4.60, ps < .10) conditions. When the latter two conditions with low scores were taken together to increase statistical power, the intentions in the scientist-as-source and the no-source condition were significantly higher ($p < .05$). All in all, mentioning the source had no robust detectable effects, and the pattern of means even suggests that not mentioning the source was the most persuasive.

Effects on behavior. To investigate whether potential effects of the source introductions could be reported on health behavior (self-reported fruit and vegetable intake two weeks later), the same analyses were conducted again with behavior as dependent variable.

• Participants, attrition analyses, and randomization checks. Of the 147 participants, 120 participants indicated their willingness to complete the follow-up questionnaire, whereas 82 participants (56% of the sample) actually completed it (84% women, aged 17 - 27 years (M = 19.8, SD = 2.22)).

Respondents who did and those who did not participate in the two-week follow-up questionnaire were compared on the pre-test variables gender, age, pre-test intention, perceived fruit and vegetable consumption, and health value. These attrition analyses showed that the responders and non-responders did not differ significantly on all variables (ps > .29). In addition, condition did not affect whether or not people completed the questionnaire regarding actual fruit and vegetable intake (p = .68); and participants were still equally distributed over the conditions (physician-as-source; n = 15, scientist-as-source; n = 20, nutrition center employee-as-source; n = 17, student-as-source; n = 14, no-source condition; n = 16).

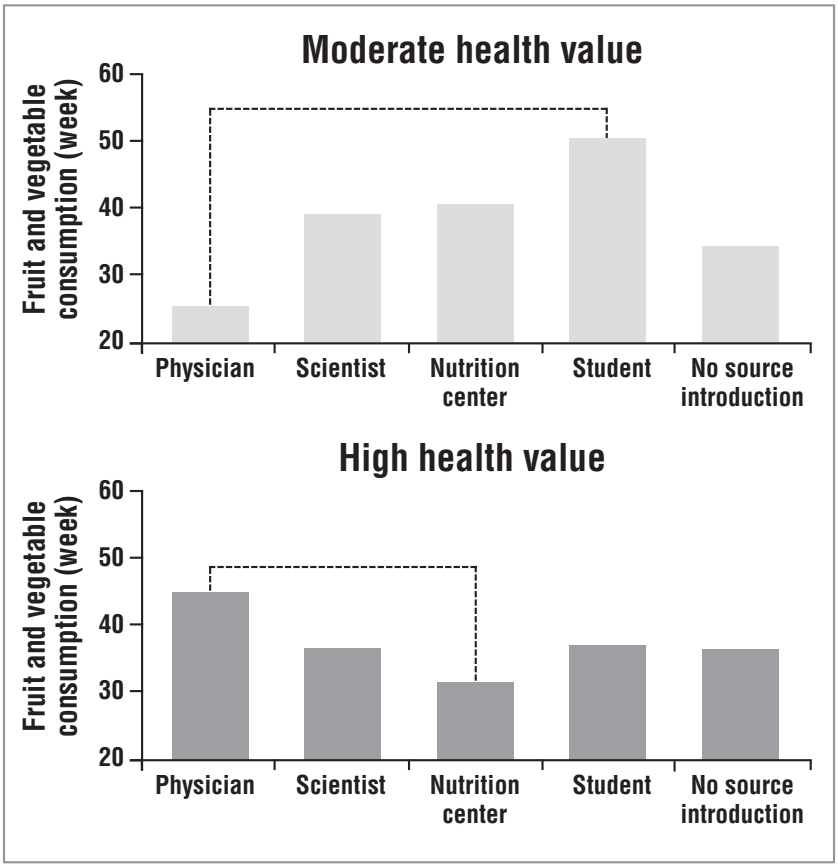
In this selection, the conditions were compared on gender (p = .40), age (p = .08), health value (p = .29), perceived fruit and vegetable consumption (p = .07), and pre-test intention. The conditions again only differed significantly on pre-test intention, $F(4, 77) = 3.44$, $p < .05$. Thus, the sample in which the analyses with regard to behavior were conducted seemed to be similar to the original sample.

• Manipulation checks. As in the complete sample, no significant differences between the conditions were found on perceived source similarity (p = .96), but the conditions differed on perceived source expertise; $F(4, 77) = 2.95$, $p < .05$, $\eta_p^2 = .13$, revealing a similar pattern of means: In the no-source condition, expertise was perceived as significantly lower compared to the physician-as-source and scientist-as-source, and in the scientist-as-source condition it was also significantly higher compared to the student-as-source (ps < .05). Regarding source typicality and authenticity, similar patterns of means were found as in the complete sample as well.

• Effects on fruit and vegetable consumption. Incomplete data were found for six participants on the measure of fruit and vegetable consumption. Therefore, these analyses were conducted in a sample of 76 participants (between 13 and 18 participants in the conditions; 86% women, aged 17 - 25 years (M = 19.7, SD = 2.10)).

No main effect of condition was found on fruit and vegetable consumption, $F(4, 69) < 1$, p = .84, $\eta_p^2 = .02$. The means were as follows: physician-as-source: M = 37.7, SE = 3.73; scientist-as-source: M = 37.9, SE = 3.07; nutrition center employee-as-source: M = 36.5, SE = 3.28; student-as-source: M = 41, SE = 3.79; no-source condition: M = 35.3, SE = 3.37. No significant contrasts could be reported. The interaction between condition and perceived health value on fruit and vegetable consumption approached significance; $F(4, 64) = 2.10$, p = .091, $\eta_p^2 = .12$. This pattern of scores in behavior was studied in more detail. Figure 6.1 displays the means in the conditions for people with a high and a moderate health value.

Figure 6.1 Interaction effect of condition and self-reported health value on fruit and vegetable consumption ▼



When health value was high, the effect of condition was not significant (p = .40, η_p^2 = .06). Contrast analyses showed that fruit and vegetable intake was only significantly higher after listening to the physician (M = 45) compared to the nutrition center employee (M = 31.6, p < .05). When health value was moderate, the effect of condition was not significant as well (p = .22, η_p^2 = .09). Contrast analyses showed that fruit and vegetable intake after listening to the physician was significantly lower (M = 25.8) compared to the student (M = 50.6; p < .05), and marginal significantly lower compared to the nutrition center employee (M = 40.7; p = .073).

Based on the above patterns of behavior we tested two other interactions with selected conditions. Firstly, on the basis of the significant contrast between the physician and the student when health value was moderate, the interaction of health value × condition (physician versus student) was tested. This interaction was significant; F(1, 21)

= 4.35, $p = .05$, $\eta_p^2 = .17$. When health value was moderate, the difference between both conditions approached significance ($p = .104$), while in the case of high health value it was not significant ($p = .36$). Secondly, on the basis of the significant contrast between the physician and the nutrition center employee when health value was high, the interaction of health value × condition (physician versus employee) was tested. This interaction was also significant; $F(1, 24) = 5.13$, $p < .05$, $\eta_p^2 = .18$. When health value was moderate, the difference between both conditions was not significant ($p = .33$), while in the case of high health value it was ($p < .05$). Although not all contrasts were significant, these results suggest that health value moderated the effects of condition on fruit and vegetable intake, especially when the physician-as-source condition was involved.

Discussion

In the framework of developing an evidence-based smartphone intervention aimed at increasing fruit and vegetable intake, the current experimental study explored the effect of (relevant) source introductions in auditory-presented health messages. With the manipulation of the introduction of the source of the message, the experimental conditions were compared to each other, but also to a control condition without source introduction.

There was no main effect of the source introductions on either intention or fruit and vegetable intake: At least for these measures it did not matter whether the source was introduced as a physician, a scientist, an employee of the nutrition center, or a student. Moreover, not mentioning the source and leaving it to the imagination of the recipient was evenly persuasive. Thus, the answer on the question whether it is beneficial to use a source introduction in the smartphone intervention is that a specific source introduction does not seem to matter. This was not caused by the manipulations being inert: The manipulation checks revealed significant differences in source perceptions. For example, the expertise of the source without source introduction or when introduced as a student was perceived as lower compared to the physician and scientist. In addition, the message communicated by the nutrition center employee was perceived as typical and authentic: The context of a national health institution may be more naturally associated with a message as conveyed here. Thus, respondents perceived relevant differences between the sources, but the source information did not influence persuasion.

An important aspect of the present manipulations that is probably related to the lack of main effects is our choice of sources, which were selected to be appropriate for use in a smartphone intervention. We did not aim to show that persuasion depends on the availability of source information in general. Therefore, we did not include obviously unreliable or non-expert sources (e.g., a carpenter). The physician, the scientist, and the employee of the nutrition center were all three considered to be appropriate for advocating fruit and vegetable consumption. In the present experiment among university

students, a student-as-source was selected not because of its expertise but because of its similarity to the target group, thereby possibly activating processes related to social comparison and social identity (Festinger, 1954; Tajfel, 2010).

The lack of difference between the experimental conditions and the no-source condition on persuasion suggests that the selected appropriate sources just were not relevant for persuasion. One explanation may be that the auditory message itself provided clues on the message that were relevant to persuasion, for example about the intent of source: Talking in this specific advocating way about fruit and vegetable consumption may reveal the source's motives (e.g., to support a healthy lifestyle), independent of the source introduction. In sum, the results suggest that regarding the development of the smartphone intervention it does not matter whether a source introduction will be used and what source will be used, at least, from the sources tested here.

These conclusions seem warranted when considering an intervention that targets all users with one message (with or without a specific source). However, with the use of contemporary technology it is possible to tailor messages to individual differences (Dijkstra, 2008; Lustria et al., 2009). In the smartphone application that is under development it might be possible to tailor the source introduction on the basis of assessed individual differences. The interaction between health value and source condition that was found in the present study provides exactly the kind of data that can be used in this individual tailoring.

The data showed that health value moderated the effects of the source conditions, although the interaction effect on behavior only approached significance. Initially, it was expected that moderately involved recipients would have been more influenced by the source, whereas high involved recipients would have been more persuaded by the message content, regardless of the source introduction. Yet, the data were not in line with this hypothesis. Specific interaction analyses revealed significant moderation effects and contrasts with the following pattern: In case of moderate health value, the physician-as-source was less persuasive than the student-as-source. Actually, in the physician-as-source condition the fruit and vegetable consumption was the lowest of all conditions (this pattern was not significant when measuring intention). In case of high health value, the physician-as-source was more persuasive than the nutrition center employee-as-source. Actually, in the physician-as-source condition the fruit and vegetable consumption was the highest of all conditions (again, this pattern was not significant when measuring intention).

This pattern may be understood by assuming that the physician speaking about the consequences of not eating sufficient fruit and vegetables induced the strongest threat. That is, the physician is usually perceived as authoritative, and it was probably the only source that was associated with illness, thereby providing an illness framework

of fruit and vegetable consumption. People with a high health value seemed to be able to handle the level of threat from the information given by the physician, while for people who moderately value their health the threat may have become too strong to face. This is in line with earlier studies that showed that participants with a moderate health value reacted with defensive self-regulation when they were exposed to a threatening health message (Dijkstra & van Asten, 2014; Pietersma & Dijkstra, 2011). Furthermore, the present results showed that for those with moderate health value, the student-as-source was the most effective, suggesting that the level of threat that was induced by the student as the messenger was acceptable but still high enough to motivate behavior. This explanation of the interactions needs further study, as it completely leans on the assumption that the physician induced the highest threat.

The moderating role of health value manifested in behavior assessed two weeks after exposure to the health message. The subtle differences between the source conditions - actually only one single word - seemed to have been translated into meaningful differences (e.g., the level of threat), which led to differences in behavior. Although not all tests reached the significance level of $< .05$, the composed interactions (i.e., the physician as source versus another source) had substantial effect sizes (partial eta squares .17 and .18, respectively). Therefore, it is worthwhile to think about how these effects might be applied in practice: The results from the interaction might be used in a computer-tailored intervention using decision rules, such as: “If health value is moderate, than the source has to be similar to the target group”.

However, although an interaction pattern was present in the experiment, none of the source introduction conditions was significantly more effective than the no-source control condition. The no-source condition is as effective as the best condition with source introduction for people with a moderate health value or a high health value. Yet, when an auditory source introduction is necessary or obligatory in a specific context (e.g., patient education), and when the target group is particularly low or high on health value, it can be worthwhile to consider the found patterns in the present study. Obviously, it will be necessary to replicate the findings among other health contexts and populations (e.g., pregnant woman or older people).

This study had some relevant limitations. Firstly, the source was introduced with only one short sentence (i.e., “My name is Marieke van Dijk and I am a [source]”), right before the content persuasive information. However, the timing of the source identification might be relevant, as providing source information after the content information may have other effects (Homer & Kahle, 1990). The source information was brief and simple. A more (complex) source information may lead to different effects as it may more strongly challenge recipients’ motivation to process the information (Kruglanski & Thompson, 1999). Additionally, a single sentence might not be sufficient to represent every source in a typical and likely way; it seems necessary to match a source introduction on other

voice or source characteristics (such as age). A second limitation is that only one voice of one unique actress, claiming to be a physician or another relevant professional, was used. Although the voice was selected to be a "standard" voice without disturbing or deviating pronunciations and accents, it cannot be ruled out that other voices should have led to other results. Research suggests that voice can play a major role in impression formation and stereotyping (Ko, Judd, & Blair, 2006), also specifically related to competence and occupation (Ko, Judd, & Stapel, 2009; Yamada, Hakoda, Yuda, & Kusuhara, 2000). Thirdly, the participants were all students. Although one condition (student-as-source) was meant to represent effects of applying a source from the target group, students comprise a rather narrow sample when it comes to age, level of education, health, and more. It may be that in a sample with more variance source introductions do have main effects or different interaction effects. Finally, the behavioral data on fruit and vegetable consumption were only available from about 56% of the participants of the original sample. Although this selection did not differ from the original sample on relevant variables, it cannot be ruled out that the specific pattern of outcomes is related to the selection.

The present study was primarily conducted in the framework of developing a comprehensive smartphone intervention. The findings might serve as guidelines when developing an online intervention to stimulate fruit and vegetable consumption via the auditory channel. In intervention development protocols, such as Intervention Mapping (Bartholomew et al., 1998) and the PATH-model (Dijkstra & Buunk, 2008b), effective methods need to be chosen and the conditions under which they are applied need to be set in the intervention. In our experiment, the persuasive message comprised at least two integrated methods, which are argumentation and message framing. These methods can be expected to be effective only within certain parameters. An important parameter was thought to be the source of the message; only when a source of a message is perceived in a certain way, the message can be persuasive. We could only partly verify this plausible expectation, and being forced to make a choice it seems that a smartphone intervention does not need to apply source introductions. It could be argued that there are still too many uncertainties to make such a decision, but this illustrates exactly the complexity and uncertainty of evidence-based intervention development.

Chapter 7

Effects of tailoring ingredients on fruit and vegetable intake in auditory persuasion

Abstract

This experimental study focused on the effects of tailoring ingredients in health persuasion when the information is provided auditory. It is worthwhile to study this form of health persuasion as an increased use of MP3 and other auditory communication channels can be observed. Tailored messages might bring the health information closer to the self, and it is expected that recipients with poor or good perceived own health and low or high self-efficacy may respond differently to this threat. Three tailoring ingredients were tested separately and compared to a fourth condition with a generic health message (between-participants design). The tailoring ingredients tested are personalization (using the recipient's first name), providing feedback (on the personal state), and adapting the message to the recipient's value. The study consisted of three parts: 1) a pre-test; 2) exposure to the health message and an immediate post-test; 3) a follow-up measurement two weeks later that assessed respondents' (N = 112) fruit and vegetable intake. The highest intention was found after listening to the health message with personal feedback, and this pattern was especially found in people with a poor perceived own health. For recipients with low self-efficacy at pre-test, tailoring did affect fruit and vegetable intake: After listening to the personalization message, fruit and vegetable intake was higher compared to the other conditions. No significant differences were found for recipients with high self-efficacy, but fruit and vegetable intake was the lowest after the personalization message. The results are discussed within the perspectives of self-regulatory defensiveness and effort investment. This study suggests that auditory forms of tailoring can affect behavior. It seems relevant to take into account individual differences in the development of auditory tailored health interventions.

▶ Chapter 7 is based on Elbert, S.P., Dijkstra, A., & Rozema, A. *(submitted).* Effects of tailoring ingredients on fruit and vegetable intake in auditory persuasion.

Effects of tailoring ingredients on fruit and vegetable intake in auditory persuasion

To stimulate the adoption of healthy behaviors, it can be useful to tailor persuasive information to individual characteristics of the recipient (Dijkstra, 2005; Hawkins, Kreuter, Resnicow, Fishbein, & Dijkstra, 2008). Research suggests that tailored information can be more effective compared to non-tailored information (e.g., Dijkstra, 2005; Lustria et al., 2013; Noar, Benac, & Harris, 2007; Sutton & Gilbert, 2007). Until now, tailored health interventions are almost all delivered via the visual communication mode, in which recipients read the tailored information. To the best of our knowledge, computer-tailoring has not been investigated yet within the auditory mode of communication, while there is a potential value and reach of the auditory mode of communication. For instance, with technological advancements such as Audiobooks, smartphone applications and MP3-technology, persuasive texts can now also be delivered via an auditory mode in which recipients listen to the information. The auditory communication mode differs from visual forms of communication (e.g., written or pictorial) in some essential ways. For example, in auditory persuasion, the voice of the source is clearly imposed onto the recipient and the source can be perceived as salient, providing an enhanced sense of social proximity (Chaiken & Eagly, 1983; Jensen, Farnham, Drucker, & Kollock, 2000). In the current study, we aim to gain more understanding on the effects of tailoring ingredients when applied within the auditory mode of communication.

Tailoring is a 'multidimensional communication strategy' to develop individualized messages that can potentially lead to behavior change (Lustria et al., 2013). A tailored persuasive message typically includes one or multiple tailoring ingredients. These ingredients are the core aspects of tailored messages that target psychological processes which are not or to a lesser degree addressed by non-tailored messages. Three broad classes of tailoring ingredients can be distinguished (e.g., Dijkstra, 2005; 2008; Hawkins et al., 2008; Kreuter, Strecher, & Glassman, 1999): personalization, feedback, and adaptation.

First, personalization is the incorporation of one or more individual characteristics in a generic text, for example by stating: "Dear Alice, hereby we provide you with some new information on the outcomes related to insufficient fruit and vegetable consumption". In this example the receiver's first name, the personalization ingredient, is incorporated into a generic text. In personalization, the recipient is addressed explicitly. Second, it is possible to add individualized feedback about a certain attitude or behavior, such as medication adherence: "You indicated that you experience few difficulties with taking your medication, that is very good". Feedback is also explicitly referring to the recipient.

Finally, adaptation or content matching refers to an adjustment of the content information (arguments, recommendations) in a way that it matches with relevant characteristics of the individual recipient. An adapted persuasive text for an adolescent on alcohol consumption might differ from a text aimed at older people, for instance by taking into account social aspects of drinking for adolescents. In adaptation, the recipient may not be aware that the information is designed for him or her personally. There is evidence available for the effectiveness of the three ingredients separately in textual messages (Cesario, Grant, & Higgins, 2004; Dijkstra, 2005; Oenema & Brug, 2003; Skinner, Strecher, & Hospers, 1994), but not in auditory messages.

Investigating the tailoring ingredients might further increase understanding on the parts of the message that can be effective. In addition, different studies investigated why tailored messages can have beneficial effects on persuasion by looking at the underlying psychological processes involved (Hawkins et al., 2008; Kreuter, Bull, Clark, & Oswald, 1999). Most importantly, individually tailored information (including elements of personalization, feedback and / or adaptation) is perceived as personally relevant. This can be understood as self-referent encoding: Recipients interpret the information against the background of the self (Rogers, Kuiper, & Kirker, 1977). For instance, a study on personalization showed that it increased the number of self-referent thoughts of recipients (Dijkstra & Ballast, 2012). In addition, the information that is perceived as personally relevant might receive more attention. Based on the elaboration likelihood model (ELM; Petty & Briñol, 2012; Petty & Cacioppo, 1986), the personally relevant information can lead to careful consideration and higher elaboration, which is in turn associated with higher potential for persuasion (Kreuter et al., 1999a; Oenema, Tan, & Brug, 2005). Self-referent encoding might thus stimulate central processing of the content persuasive information (Dijkstra, 2008; Rogers et al., 1977).

Typically, in the domain of health with its aversive health outcomes, this self-referring and central processing may elicit a state of threat (based on the extended parallel process model; Maloney, Lapinski, & Witte, 2011; Witte, 1992, 1994). Especially personalization and feedback that are explicitly addressing the recipient might induce a threat. This threat may be the primary motivation to comply to the persuasive message. Whether this threat is transferred into behavior may however depend on individual differences in self-efficacy (Peters, Ruiter & Kok, 2012; Witte, 1992). Therefore, besides testing the efficacy of the tailoring ingredients in auditory persuasion, it is investigated how these effects vary for recipients differing in their perception of the own health and self-efficacy.

People who perceive the own health as relatively poor or good may react differently to the information on relevant health outcomes, for example, related to cancer prevention through fruit and vegetable consumption. When the own health is perceived as relatively poor, the information might be more relevant; recipients with a poor perceived

health have more to gain from the information as they can use the information to improve the own health. It is expected that these recipients will be persuaded by the persuasive health information, regardless of the applied tailoring ingredients. In contrast, the information is less relevant for recipients who perceive the own health as relatively good; these recipients may have the feeling that they cannot necessarily use the information. Therefore, a defensive response can initially be expected in these recipients, potentially after the information becomes more self-relevant when tailoring ingredients are applied.

Self-efficacy refers to beliefs about one's capabilities to adequately perform a certain behavior, and it has been shown to be an important predictor of fruit and vegetable intake, the behavior that will be central in the current study (Guillaumie, Godin, & Vézina-Im, 2010; Kreausukon, Gellert, Lippke, & Schwarzer, 2012). Recipients who report difficulties eating sufficient fruit and vegetables (i.e., having low self-efficacy regarding this behavior) may be expected to display defensive self-regulatory processes after being exposed to the threatening health information (fear control), as they might experience they are unable to perform the behavior. This might consequently lead to lower persuasion. On the other hand, recipients high in self-efficacy may experience no or few difficulties in performing the behavior and possibly have found ways and resources to perform the behavior themselves. The threat can be transferred into behavior change in those people (danger control; Maloney et al., 2011; Witte, 1992, 1994).

In sum, tailoring ingredients bring the persuasive information, probably to a different degree, closer to the self. The threat they induce may be solved by changing the health behavior in the advocated direction, but this can depend on the perceived own health and self-efficacy expectations. The present study aims to test the effect of each of the three tailoring ingredients in an auditory persuasive message. Personalization was operationalized as mentioning the respondent's first name in the message three times; feedback was given on the self-reported fruit and vegetable consumption, and adaptation was operationalized as providing persuasive information that was congruent with the respondent's choice of his or her most important value (i.e., enjoying life versus health). The control condition comprised of a generic auditory persuasive message. Perceived own health status and self-efficacy regarding the intake of sufficient fruit and vegetables were tested as moderators and the dependent variables were represented by both the intention to increase fruit and vegetable intake (assessed immediately after the manipulation) and self-reported fruit and vegetable intake at 2-week follow-up.

Method

Design. The current study investigated the persuasive influence of the tailoring ingredients personalization, feedback and adaptation in auditory persuasion in a between-participants design. Besides these three experimental conditions, a fourth condition with a generic health message was included as a control condition.

Self-efficacy, or the perceived difficulty of the behavior, was tested as a moderating variable. In total, the study consisted of three parts: 1) a pre-test; 2) exposure to the health message and an immediate post-test, and; 3) a follow-up measurement two weeks after the immediate post-test. This seems a relevant and appropriate period in relation to the low intensity of the intervention (respondents were only exposed to the information once).

Recruitment. Respondents were either recruited as first-year psychology students of the University of Groningen or as (former) students from a participant pool of the local psychology department with a general interest in joining scientific research. Respondents were told that they would participate in an online study on communication and lifestyle and received either partial (first-year psychology) course credits or a monetary compensation (€ 6) for completing all three parts. Data were only included in the statistical analyses when they were available from all three measurements.

Procedure. The measurements and the tailored auditory health message were all presented online. At pre-test, a screen with informed consent information was presented to the respondents, addressing the confidentiality and duration of the study (<15 minutes per study part). Then, respondents could answer the pre-test questions, partly consisting of questions for tailoring purposes. After having filled in the pre-test, respondents were sequentially assigned to one of the four experimental conditions in order of completion of the pre-test. The first names of participants who were assigned to the personalization condition were, then, used to develop a personalized message for each respondent in a professional recording studio. After this recording session, 17 extra respondents signed up and completed the pre-test questionnaire. These exceptions were distributed evenly across the three remaining conditions, for logistical reasons only. On average, about one month after the pre-test, the manipulations and immediate post-test were distributed. The time between the pre-test and the manipulation varied between 8 and 53 days (M = 26, SD = 9.9).

Respondents were then exposed to an auditory message advocating fruit and vegetable consumption, that was either generic, personalized, that provided feedback, or that was adapted. To ascertain that the volume of the actual health message was sufficient and convenient, an auditory recording was presented with instructions on volume regulation. While listening to this instructive recording, respondents could adjust the volume to their individually preferred level. Subsequently they listened to the health message. Finally, post-test measurements were taken immediately after exposure to the health message. Two weeks after having filled in the immediate post-test, respondents received the link to the follow-up questionnaire on fruit and vegetable intake by e-mail. The time between the immediate post-test and the moment that we received the follow-up data varied between 13 and 31 days (M = 15.4, SD = 3.5). If respondents did not fill in the post-test or follow-up questionnaire within five days, a reminder was sent

via e-mail. When necessary, more reminders were sent (maximally three reminders per questionnaire).

The tailoring conditions. The auditory health messages were all spoken by a female actress who was selected in collaboration with the recording studio. It was the intention to select a voice that was gender congruent; that is, a high-pitched and feminine voice. The professional actress was instructed to use her voice as normal and natural as possible and to speak as a newsreader. All messages were recorded in one session. The tailored messages were created by copying and pasting different auditory fragments in such a way that it sounded natural.[1] Thus, in all four conditions, respondents were exposed to an auditory health message in which one specific tailoring ingredient was applied (except for the generic health message; see Appendix 1e and 2, QR-codes 8 and 9 to get an impression of the messages). The recordings were mastered in 96 kHz 24 bit and converted to standard mono MP3 format (128 kbps).

• *The generic message.* The generic health message was positively framed, referring to both positive health outcomes that can be approached (e.g., increased physical stamina) and negative health outcomes that can be prevented (e.g., a decreased risk for cancer and heart diseases; 223 words in total, 88 seconds). The presented outcomes were based on an earlier study that applied textual health messages on fruit and vegetable consumption (Dijkstra, Rothman, & Pietersma, 2011). In addition, the generic text contained two sentences (approximately 10% of the total amount of text) referring to the hedonic aspects of fruit and vegetable consumption (e.g., smell, freshness, taste, ease). The message ended with a closing sentence ("Thus, eating sufficient fruit and vegetables does not necessarily take a lot of effort and it contributes to a healthy lifestyle").

• *The personalized message.* The personalized message (231 words in total, 92 seconds on average) consisted of the same content as the generic health message, but now with the incorporation of the respondents' first name for three times. The message started with "Dear [respondent's first name]"; it was incorporated halfway the message by stating "So, dear [respondent's first name], if you eat sufficient fruit and vegetables…", and in one of the final sentences as well by stating "Furthermore, fruit and vegetables do have a nice smell and taste, don't you think [respondent's first name]"?

[1] More specifically, the feedback and personalization sentences were carefully integrated with the generic health message content (which was recorded independently for the personalization version), while taking into account the speech rate and natural pauses of the speaker.

• *The feedback message.* In the feedback message, before listening to the generic text, three sentences on the self-reported fruit and vegetable intake were added. Four feedback versions were created (on average 255 words, 98 seconds) based on the respondents' reported fruit and vegetable intake of the previous week, as indicated at pre-test. Based on this measurement, it was calculated whether it was sufficient or insufficient against the background of the contemporary Dutch recommendations for fruit and vegetable intake (see later). Then, the feedback was provided on a combination of either sufficient or insufficient fruit and vegetable consumption, respectively (sufficient fruit and vegetable consumption (n = 4), insufficient fruit and vegetable consumption (n = 8), sufficient vegetable consumption but insufficient fruit consumption (n = 5), or sufficient fruit consumption but insufficient vegetable consumption (n = 10)). Each combination consisted of three types of feedback, based on Dijkstra (2008) and Oenema & Brug (2003): "You indicate that you eat (in)sufficient fruit and vegetables [objective feedback / personal feedback], that is very good (that is a shame) [evaluative feedback]. Try to continue this (try to make some changes) [action-oriented feedback / adjustment feedback]; what people eat influences how healthy they are and how they feel". In any case, the last sentence of the feedback replaced the first sentence of the generic health message and it was designed and recorded in a way that it could easily be implemented.

• *The adaptation message.* In the adaptation message, the content was adapted to the respondents' "most important value in life" as indicated at pre-test. This is based on the concept of values that are important in defining oneself and that may consequently determine which arguments one will find persuasive (e.g., Snyder & DeBono, 1985). Two versions of the generic health message were created. When respondents indicated that health is their most important value in life, they were exposed to a message on the positive health effects of sufficient fruit and vegetable intake only (e.g., lowering health risks and preventing weight gain, without referring to any hedonic aspects of fruit and vegetable consumption; 229 words in total, 91 seconds). When respondents indicated that 'enjoying life' is their most important value, they were exposed to a hedonic text that only stressed the unique smell and taste of fruit and vegetables, and the ease of eating fruit and vegetables (242 words in total, 101 seconds). Prior to both messages a short title was mentioned ('the vulnerability of life' versus 'enjoying life').

• *Tailoring questions.* Throughout the pre-test, several questions for tailoring purposes were asked. Firstly, the information needed for the personalization message was the respondents' first name. Secondly, for the feedback message, distinct indexes for fruit and vegetable consumption were used to determine whether fruit and vegetable consumption was (in)sufficient, according to recommendations as formulated by the Netherlands Nutrition Centre (2011): A daily consumption of two pieces of fruit and two-hundred grams of vegetables for an adult population. For respondents who received the feedback message, the combination of these scores was used to determine which

feedback the respondent would be provided with. More specifically, cut-off points for sufficient weekly consumption were set at 28 (7 x 4) portions of 50 grams of vegetables and 14 (7 x 2) pieces of fruit (two tangerines were calculated as one piece, as well as five table spoons of apple sauce, a commonly used product in the Netherlands), respectively.

Finally, for the adaptation message, the respondents' "most important value in life" was assessed with the question: "People differ in what they find important, in the values that they strive for. What is most important to you?" The answering options were 'health' and 'enjoying life', and 79% of all respondents chose 'enjoying life' over 'health'. For respondents who were assigned to the adaptation message condition (n = 29), the answer on this item was used to determine which version of the auditory persuasive text had to be used. Only three respondents received the health-adaptation message.

Measures • *Pre-test measures.* At pre-test, gender, age and cultural background were assessed. Next, participants were asked to indicate to what extent they considered themselves as healthy (perceived own health status, based on CBS, 2013). This item could be answered on a six-point scale with answering options ("my health is…") 'very good' [1], 'good' [2], 'fair' [3], 'moderate' [4], 'poor' [5] and 'very poor' [6]. The item was recoded to indicate that high scores corresponded with good perceived health (M = 4.88, SD = .71).

Next, the intention to start consuming more fruit and vegetables in the next year was assessed in two formats: "I am planning to…", and "It is likely that I will…". These items could be answered on seven-point scales ranging from 'absolutely not' / 'very unlikely' [1] to 'absolutely' / 'very likely' [7]. The item scores were averaged to create a composite measure score of pre-test intention (r = .77, p < .001, M = 4.12, SD = 1.31).

In addition, two items assessed perceived consumption of fruit and vegetables, respectively. These items could be answered on a five-point scale ('minimal' [1] / 'few' [2] / 'slightly insufficient' [3] / 'sufficient' [4] / 'more than sufficient' [5]). Again, a composite measurement was created (r = .45, p < .001, M = 3.52, SD = .89).

Two items assessed perceived difficulty of performing the advocated behavior, eating sufficient fruit and vegetables, respectively: "How difficult is it for you to eat sufficient fruit/vegetables"? Both items could be answered on five-point scales ('not difficult at all' [1] / 'not difficult' [2] / 'neutral' [3] / 'difficult' [4] / 'very difficult' [5]). A composite measurement was created (r = .15, *ns*; M = 2.41, SD = .78), with the low correlation reflecting the differential nature of fruit consumption and vegetable consumption.

Finally, respondents were asked to complete a detailed and validated frequency questionnaire on their fruit and vegetable intake (self-reported fruit and vegetable intake, as used for tailoring purposes as well; Bogers, van Assema, Kester, Westerterp, & Dagnelie, 2004). Respondents could indicate how often on average they ate or drank

products from several fruit and vegetable categories during the previous week. The answering options ranged from 'never or less than 1 day a week' [0], '1 day a week' [1] to 'every day' [7]. Next, they were asked to indicate the amount of intake per category of fruit or vegetables (answering options ranged from 'no pieces / glasses / serving spoons' to 'five or more pieces / glasses / serving spoons'). The main categories were 'cooked vegetables', 'raw vegetables / salad', 'fruit / vegetable juice', 'tangerines', 'oranges / grapefruits / lemons', 'apples / pears', 'bananas', 'other fruit' and 'apple sauce'. The average number of days per week and the pieces of fruit and vegetable portions (defined as 50 grams each) were multiplied for each category and added to create a composite index of weekly fruit and vegetable intake (scale ranging from 5 to 128; M = 40.5, SD = 17.4)

• ***Post-test measures.*** At the immediate post-test, questions regarding message understanding, message credibility and the extent to which the information was perceived as personally directed were asked to check whether the manipulations were received as intended. The questions were "To what extent was the information directed at you personally?", "To what extent were you able to understand the message?" and "To what extent do you think the message was credible?" These 1-item measures could be answered on seven-point scales ranging from 'not personal at all' [1] to 'very personal' [7], from 'not at all' [1] to 'very good' [7] and from 'not credible at all' [1] to 'very credible' [7]. The main dependent variable at the immediate post-test, intention to start consuming more fruit and vegetables, was assessed with six items regarding the planning and likelihood of starting to perform the behavior in one month, six months, and five years respectively (α = .97, M = 5.05, SD = 2.09). To lower the probability of participants answering strategically (remembering their pre-test score), these items could be answered on nine-point scales ranging from 'absolutely not' / 'very unlikely' [1] to 'absolutely' / 'very likely' [9]. Subsequently, process variables not pertinent to the current study were administered. At the 2-week follow-up, the main dependent variable was administered: Respondents completed the frequency-questionnaire on their personal fruit and vegetable consumption of the last week, as assessed at pre-test (Bogers et al., 2004).

Statistical analyses. ANOVAs and ANCOVAs were used to perform the manipulation checks and the main analyses, respectively. In the main analyses, immediate post-test intention and self-reported fruit and vegetable consumption two weeks later were the dependent variables. Pre-test intention, perceived own health, perceived difficulty of eating sufficient fruit and vegetables, perceived *and* self-reported intake of fruit and vegetables were standardized and included as covariates in the main analyses, as these variables are conceptually related to the reception of health messages on fruit and vegetable intake. In addition, perceived own health and perceived difficulty of eating sufficient fruit and vegetables (as a measure of self-efficacy) were tested in interaction with condition in a saturated model to see whether there were any moderating

effects on self-reported fruit and vegetable intake. To further explore interaction effects, simple main analyses were conducted at two levels (low/high) of the moderator. To this purpose, the complete dataset was used to model participants as scoring high or low, by adding and subtracting one standard deviation to the standardized means, respectively (Cohen, Cohen, West, & Aiken, 2003).

Results

Participants. In total, 137 respondents completed the online pre-test questionnaire. Eighty-four percent of them (n = 115) listened to the health message in one of the four conditions and completed the immediate post-test. After that, another three respondents dropped out (82% response rate of the total sample). The final sample consisted of 112 respondents (80% females), varying in age from 17 to 54 years (M = 23.7, SD = 7.00), randomly distributed over the four conditions: Generic message (n = 32); personalized message (n = 24); feedback message (n = 27); adaptation message (n = 29)[2]. On the basis of the self-reported fruit and vegetable consumption at pre-test (the frequency scores on fruit and vegetable consumption), 21% of the respondents was classified as consuming insufficient vegetables (but sufficient fruit), 24% was classified as consuming insufficient fruit (but sufficient vegetables), 35% was classified as consuming both insufficient fruit and vegetables, and 20% was classified as consuming both sufficient. The measure of *self-reported* fruit and vegetable consumption at pre-test had a significant and positive correlation with the *perceived* consumption of fruit and vegetables (r = .64, p < .001) and this correlation remains similar when controlled for the perceived own health and pre-test intention.

Randomization check. Univariate analyses were conducted to analyze whether the conditions differed on relevant pre-test measures. No significant differences between conditions were found regarding the distribution of gender (p = .21), age (p = .21), pre-test intention (p = .21), self-reported fruit and vegetable consumption at pre-test (p = .55; when dichotomized as insufficient versus sufficient, p = .06 and p = .37 for fruit and vegetable consumption, respectively), the most important value (p = .38), perceived own health status (p = .21), the time it took respondents to complete one of the measurements (respondents who did not complete it in one session were excluded in this analysis; ps > .34), time between pre-test and immediate post-test measurements

[2] Four respondents indicated they had a non-Dutch cultural background. Furthermore, two types of recruitment were used; exactly half of the respondents were first-year psychology students and the other half were mostly (former) students interested in joining scientific research. When we conducted the main analyses without the four non-Dutch respondents, the interaction between condition and self-efficacy on self-reported fruit and vegetable intake became non-significant, including contrasts (p = .13, η_p^2 = .06). In addition, we did not control for the type of recruitment in our main analyses as the pattern of results did not change after including this factor as a covariate.

(p = .72), time between post-test and follow-up measurements (p = .89), and number of sent reminders at immediate post-test (p = .18) or follow-up (p = .73). Only perceived fruit and vegetable consumption and perceived difficulty of the behavior were not randomly distributed across conditions (ps < .05). Therefore, all subsequent analyses were performed while controlling for these variables.

Attrition analyses. We assessed whether dropouts after T1 significantly differed from the respondents who completed the study. The groups were compared on gender, age, pre-test intention, perceived and self-reported fruit and vegetable consumption at pre-test, perceived own health status, the most important value, and perceived difficulty of the behavior. The results showed that dropouts significantly differed on the variable pre-test intention (dropouts reported a significantly lower intention, p = .031), and marginally significantly on the most important value (dropouts reported health as their most important value more often; p = .052) and on self-reported fruit and vegetable consumption (dropouts reported a higher fruit and vegetable intake at pre-test; p = .062). Condition did not affect whether or not respondents completed the study (p = .62).

Manipulation checks. Respondents who received the personalized message or who received feedback on their own fruit and vegetable consumption perceived the information as more personally directed at them (M = 4.25, SD = 1.62 and M = 4.00, SD = 1.44, respectively) compared to respondents who were exposed to the generic message (M = 2.94, SD = 1.32) or adaptation message (M = 2.62, SD = 1.27); $F(3, 108) = 8.70$, $p < .001$, $\eta_p^2 = .20$, contrasts $ps < .01$.

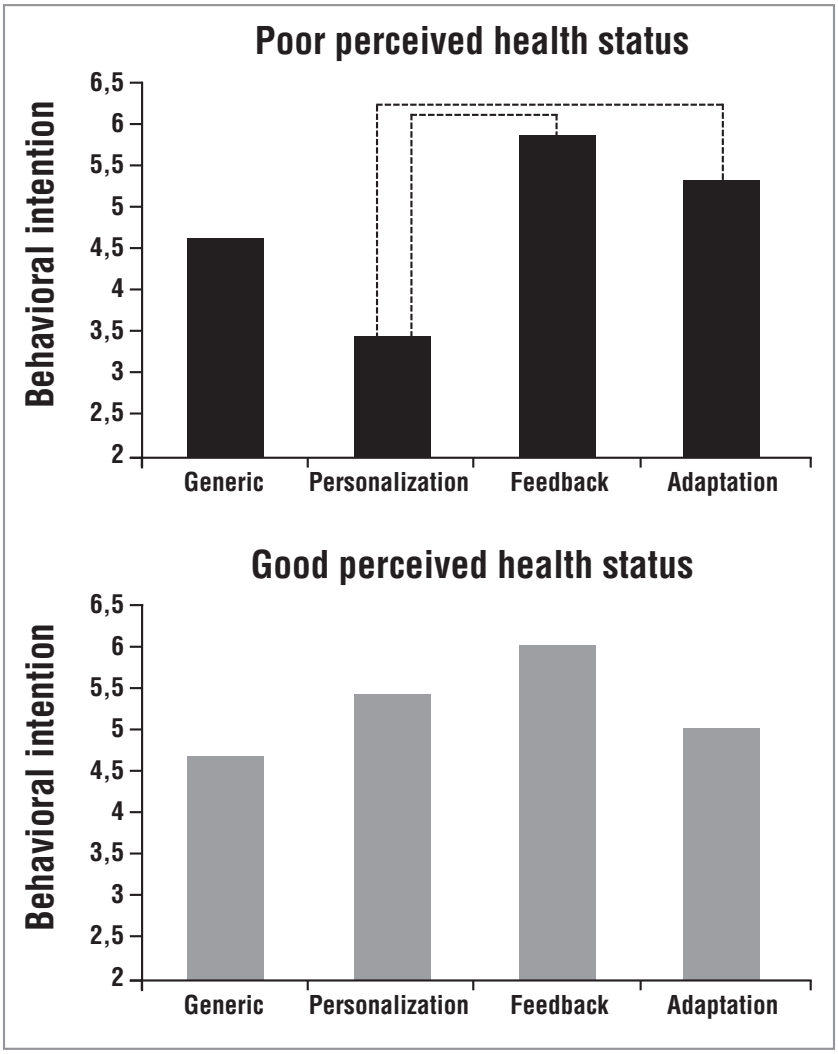
Furthermore, the conditions did not differ significantly regarding the extent to which respondents reported to understand the message, $p = .58$, $\eta_p^2 = .02$. A significant difference was found on perceived message credibility: $F(3, 108) = 4.32$, $p < .01$, $\eta_p^2 = .11$: The message in the adaptation condition was perceived as significantly less credible compared to the messages in the other three conditions, contrasts $ps < .05$. This seemed to be caused particularly by the low credibility ratings of the respondents who received the hedonic version of the message. However, when this variable was controlled for in the main analyses on behavior, only minor changes in F-values and p-values were found that did not alter the interpretation of the findings.

Effects on intention. The main effect of condition on the intention to increase fruit and vegetable intake was significant, $F(3, 103) = 3.52$, $p < .05$ $\eta_p^2 = .09$. The highest intention was found after listening to the health message with personal feedback (M = 5.92, SE = .37), which was significantly higher compared to the personalized message (M = 4.31, SE = .37, p = .004) and the generic message (M = 4.73, SE = .32, p < .05). A marginally significant difference was found between the personalization and adaptation message (M = 5.20, SE = .34, p = .075).

Next, the interaction between condition and perceived own health was added to the statistical model; this interaction was significant as well, $F(3, 100) = 2.80$, $p < .05$

η_p^2 = .08. Within this model, the main effect of condition remained significant. Figure 7.1 displays the means in the conditions for people with a poor and a good perceived health status.

Figure 7.1 The effect of condition on the intention to increase fruit and vegetable intake for respondents with a poor and good perceived health status, respectively ▼



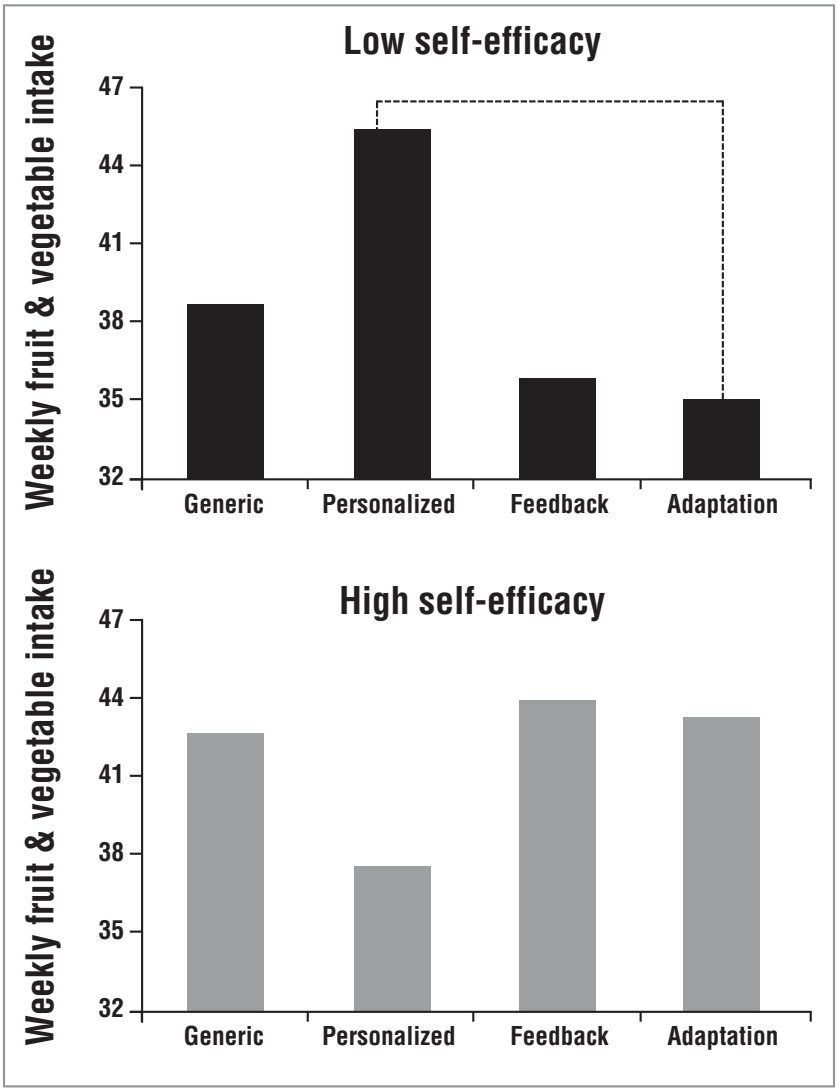
In case of poor perceived health, there was still a significant main effect of condition, $F(3, 100) = 4.37$, $p = .006$, $\eta_p^2 = .12$. The mean intentions were as follows: Generic message: $M = 4.67$; personalized message: $M = 3.48$; feedback message: $M = 5.92$; adaptation message: $M = 5.37$. Intention was significantly lower after the personalized message compared to the feedback message ($p = .005$) and the adaptation message ($p = .002$) and it was marginally significantly lower than the generic message ($p = .057$). The remaining contrasts were not significant.

In case of good perceived health, condition did not significantly affect intention, $F(3, 99) = 1.48$, $p = .22$, $\eta_p^2 = .04$. The mean intentions were as follows: Generic message: $M = 4.74$; personalized message: $M = 5.48$; feedback message: $M = 6.07$; adaptation message: $M = 5.02$. No significant contrasts could be reported, but a marginally significant contrast was found between the generic message and the feedback message ($p = .052$).

Furthermore, the interaction between condition and perceived difficulty of the behavior (self-efficacy) was tested; this effect was however not significant ($p = .65$, $\eta_p^2 = .02$). Thus, self-efficacy did not moderate the effect of condition on intention, but perceived own health status did. This effect seemed especially caused by the intention in the personalization condition depending on the perceived own health status. This was further studied by computing correlations between perceived own health and intention (while controlling for the covariates as used in the model tested above). Overall, this correlation was positive, but low ($r = .16$, $p = .10$), and it was significant in the personalization condition only ($r = .59$, $p < .01$).

Effects on health behavior. The same analyses as reported above were conducted with self-reported fruit and vegetable intake as dependent variable. Now, the main effect of condition was not significant; $F(3, 103) = 1.03$, $p = .38$, $\eta_p^2 = .03$, neither was the interaction of condition with perceived own health status; $F(3, 100) < 1$, $p = .64$, $\eta_p^2 = .02$. A significant interaction was found, however, between condition and perceived difficulty of performing the behavior, $F(3, 100) = 2.72$, $p < .05$, $\eta_p^2 = .08$. Figure 7.2 displays the means in the conditions for people with low and high self-efficacy.

Figure 7.2 The interaction between condition and self-efficacy on fruit and vegetable intake at 2-week follow-up ▼



Note. The estimated means of weekly fruit and vegetable intake (in portions) are given, controlled for the pre-test measures intention, the perceived own health, perceived and self-reported consumption of fruit and vegetables.

In case of low self-efficacy, condition had a significant effect on behavior, $F(3, 100) = 2.91$, $p < .05$, $\eta_p^2 = .08$. The mean scores reflecting weekly fruit and vegetable intake were as follows: Generic message: $M = 38.65$; personalized message: $M = 45.46$; feedback message: $M = 35.90$; adaptation message: $M = 35.15$. Post-hoc contrasts showed that the intake of fruit and vegetables after listening to the personalized health message for this group of people was significantly higher compared to the adaptation message ($p = .006$), and marginally significantly higher compared to the generic and the feedback message ($ps < .10$).

In case of high self-efficacy, no significant effect of condition was found $F(3, 100) < 1$, $p = .56$, $\eta_p^2 = .02$. For these people, tailoring did not significantly affect fruit and vegetable intake after two weeks. The means reflecting weekly fruit and vegetable intake were as follows: Generic message: $M = 42.59$; personalized message: $M = 37.50$; feedback message: $M = 43.83$; adaptation message: $M = 43.15$. No significant contrasts were found.

In order to illustrate our findings on behavior, the correlation between perceived difficulty and self-reported fruit and vegetable consumption (controlled for the covariates as used in the above model) was inspected. This was not significant overall and in all four conditions separately. Yet, the correlations reflected the observed pattern; it was positive in the personalized message condition ($r = .35$, $p = .13$), whereas it was negative in the other three conditions, approaching significance in the adaptation message condition ($r = -.35$, $p = .08$).

Additional analyses. First, we performed the analyses on behavior in two samples with selected respondents only. For instance, it can be reasoned that the 17 respondents who signed up later would show differences compared to those who signed up more quickly, for example in terms of research interest or enthusiasm, which could in turn affect differences between the conditions. Thus, the analyses on behavior were performed without these respondents. In addition, it can be reasoned that the respondents who already consumed sufficient fruit and vegetables were not in need of a tailored health message. The analyses on behavior were performed without these respondents as well. However, in both cases only small differences in F-values and p-values were observed, that did not alter the interpretation of the findings on behavior.

Second, as there was substantial variance in: a) the number of days between pre-test and post-test and between post-test and follow-up; b) the (electronically assessed) time in minutes it took the respondent to complete the measurements (respondents were excluded for these analyses when they did not complete the questionnaire in one session), and; c) the number of reminders sent for the post-test and follow-up, the above statistical analyses were repeated when controlling for these variables one by one. Again, only minor changes in F-values and p-values were observed, that did not alter the interpretation of findings.

Discussion

In the current study, we examined the influence of tailoring ingredients in auditory health persuasion aimed at increasing fruit and vegetable intake. The observed effects on intention and behavior give us a first indication that tailoring ingredients can influence persuasion when applied via the auditory mode of communication. The found patterns on both intention and behavior were not in line with the initial expectations. Recipients who perceived the own health as good showed no significant differences on intention between the conditions, and recipients who perceived the own health as poor showed a significantly lower intention after listening to the personalization message. Tailoring did influence self-reported fruit and vegetable intake two weeks later as well, but only in people who perceived performing the behavior as relatively difficult. Yet, the finding that this group showed a significantly higher fruit and vegetable intake after listening to the personalization message was not expected on forehand.

The auditory message with feedback on the individual's fruit and vegetable intake led to the highest intention. Feedback may have provided new information that was not available in both other conditions: An interpretation of the individual's fruit and vegetable consumption against food guidelines. Besides this, the feedback is explicitly self-referencing (Dijkstra, 2008; Rogers et al., 1977), which also may have contributed to its effect. However, the feedback condition was marginal significantly more persuasive compared to the personalization condition that was also explicitly self-referencing. In line with earlier findings this suggests that self-referencing can also backfire (Dijkstra & Ballast, 2012; Dijkstra, 2014). In addition, the moderation effect of perceived own health showed that the persuasive effect of personalization strongly depended on perceived own health, while feedback was effective independent of perceived own health. It seems that the specific way of self-referencing can make an essential difference. Process research is needed to further corroborate our theorizing on the effects of personalization and the differences between personalization and feedback.

As no main effect on self-reported fruit and vegetable intake was detected, it can be concluded that none of the three tailoring ingredients was more effective than the generic message when it comes to actually influencing behavior. However, the effect was moderated by self-efficacy, also when respondents who already consumed sufficient fruit and vegetables were excluded. In people with low self-efficacy the personalization condition stood out: It led to the highest consumption compared to the other conditions; even somewhat higher than the highest fruit and vegetable consumption reported in people with high self-efficacy. It may be that personalization was so strong that it motivated people with low self-efficacy to make a larger investment, thereby engaging in an increased level of effort spending. It may be that the combination of: 1) personalization and; 2) auditory persuasion, was especially powerful. In auditory personalization the source of the persuasive information actually pronounces the recipient's first name, which

may bring the persuasive information even more close to the self, as if someone is speaking to the recipient personally (Chaiken & Eagly, 1983; Jensen et al., 2000).

The question why personalization led to more persuasion in those with low self-efficacy may be related to an empirical matter regarding the level of threat that was induced: When the level of threat becomes higher, as in the combination of personalization and auditory persuasion, thresholds may be passed and different reactions may occur. For example, we did not expect a defensive reaction in people high in self-efficacy. Still, it was found that the extreme closeness of the personalized information led to a relative drop in persuasion even in those with high self-efficacy. On the other hand, people with low self-efficacy were expected to get defensive when they would be threatened. It may be that the auditory personalization was so powerful in self-referencing for this group that it reinstated unbiased and more central processing (Dijkstra & Ballast, 2012). With regard to the relative drop in persuasion after personalization in people with high self-efficacy, two other interpretations are possible. This group might have been distracted by the personalization elements as peripheral cues while being engaged in central processing, or the manipulation of their own name being mentioned three times might have been too explicit and served as a forewarning, thereby eliciting a response that was relatively defensive (Dijkstra, 2008). All in all, it may be that tailoring in auditory persuasion, in contrast to written/pictorial tailoring, induces some effects that are unknown yet.

The results should be interpreted against the background of some limitations. First, the adaptation message was perceived as less credible compared to the other versions of the message. Indeed, one can imagine that the hedonic perspective on fruit and vegetable intake without addressing the health benefits lacked credibility. In addition, the adapted information was not perceived as personally directed to the respondent. This replicates earlier findings regarding adaptation as a tailoring ingredient (Dijkstra, 2005), and it proposes that adaptation as tailoring ingredient may work through other processes than self-referencing (Dijkstra, 2005; Williams-Piehota, Schneider, Pizarro, Mowad, & Salovey, 2003). Furthermore, the distribution of the respondents between the two adaptation versions was skewed: Almost all respondents listened to the hedonic health message. However, this might not have influenced the results as we did not aim to compare the effects of the two adaptation versions. It seems that in this sample of mostly (former) students, the question on one's most important value that was the basis of the adaptation did not assess much variation, although this might be different in other populations. Indeed, this specific sample was appropriate to join this study on basic tailoring mechanisms, but they are possibly not representative for other populations.

As the current study did not compare the auditory mode of communication with the commonly used visual mode, it remains unclear whether and how auditory tailoring works qualitatively different from textual tailoring. Although one can think of (audio-)visual

intervention elements that can be persuasive as well (e.g., avatars or video fragments), we focused on dismantling the effects of three tailoring ingredients in auditory persuasion without any visual cues being available. In addition, we aimed to look at the effects after only one single moment of exposure to the auditory presented tailored information. This means the findings in this study might be useful in developing long-term tailored health interventions applied via the auditory mode of communication.

In sum, the current results suggest that auditory tailoring can have effects on behavior up to two weeks later after a single moment of exposure (about 90 seconds) to the tailored information only. It is possible that the auditory mode of communication in itself did enhance the salience of the information as the voice of the source is very clearly imposed onto the recipient (Chaiken & Eagly, 1983). The results showed that auditory tailoring can be effective in some particular circumstances. Respondents with high self-efficacy showed relatively high fruit and vegetable intake scores after listening to either the generic message, the feedback message or the adaptation message. For respondents with low self-efficacy only high fruit and vegetable intake scores were found after listening to the personalization message. It seems relevant to take into account individual differences in the development of auditory tailored health interventions but possibly also in health persuasion contexts in daily life (e.g., telephone counselling with a dietician). Furthermore, it can be recommended to apply personalization in a careful way, as for some people this might have negative effects in the process of behavior change. This is in line with earlier studies that show positive as well as negative effects of personalization (Dijkstra, 2014; Dijkstra & Ballast, 2012). With this study that applied a new way of computer-tailoring in persuasion via the auditory mode of communication, we hope to inspire more research and practical applications in the context of developing (auditory) web-based tailored health interventions.

Chapter 8

A smartphone intervention targeting fruit and vegetable consumption: The efficacy of textual and auditory tailored health information tested in a randomized controlled trial

Abstract

Smartphone applications are increasingly used to deliver health interventions, which provide the opportunity to present health information via different communication modes. In a randomized controlled trial we tested the efficacy of a six-month intervention delivered via a smartphone application aimed at stimulating fruit and vegetable intake. Respondents were monthly exposed to either text-based or audio-based tailored health information and feedback. In addition, respondents in the control condition only completed the baseline and post-test measures. Perceived own health and health literacy were included as moderators to assess for which groups (one of the) interventions can possibly lead to health behavior change. It was hypothesized that the intervention would be more effective compared to the control condition, irrespective of the mode of communication. Within a community sample (N = 146; online recruitment with a response rate of 45%), a significantly higher fruit intake (self-report questionnaire after six months) was found after exposure to the auditory information, especially in recipients with a poor perceived health. In addition, a significantly higher vegetable intake was found for recipients with high health literacy after exposure to the textual or auditory intervention compared to the control condition. In case of relatively low health literacy, vegetable intake was the highest in the control condition. The current smartphone application has the potential to change fruit and vegetable intake up to six months later, at least for specific groups. Different effects for fruit and vegetable intake were reported, which suggests that different underlying psychological mechanisms are associated with these specific behaviors. In addition, it seems worthwhile to investigate additional ways to increase fruit and vegetable intake in recipients with low health literacy.

▶ Chapter 8 is based on Elbert, S.P., Dijkstra, A., & Oenema, A. *(revised resubmitted).* A smartphone intervention targeting fruit and vegetable consumption: The efficacy of textual and auditory tailored health information tested in a randomized controlled trial.

A smartphone intervention targeting fruit and vegetable consumption: The efficacy of textual and auditory tailored health information tested in a randomized controlled trial

An impressive number of smartphone applications or apps related to achieving a healthy lifestyle are currently available (Dennison, Morrison, Conway, & Yardley, 2013; Kratzke & Cox, 2012). In line with this, smartphone applications have been introduced as interventions within the field of health education and promotion, for example as telemedicine technologies, providing tools for health behavior change with the use of self-monitoring or feedback (e.g., Brindal et al., 2013; Hebden, Cook, van der Ploeg, & Allman-Farinelli, 2012). To the best of our knowledge, only few apps exist that actually tested an evidence-based health intervention (i.e., Brindal et al., 2013; Glynn et al., 2014; Lee, Chae, Kim, Ho, & Choi, 2010), for example with the use of behavior change techniques (Cowan et al., 2013; Dennison et al., 2013). This means there is limited knowledge on the efficacy of smartphone applications in the process of health behavior change.

Using smartphone apps to deliver an intervention can have a variety of advantages. Besides the increased availability and accessibility of smartphones and the potential of reaching many people, it provides the opportunity to use interactive technological possibilities for persuasion that may support behavior change (Brug, Oenema, Kroeze, & Raat, 2005; Kratzke & Cox, 2012). In particular, it enables the use of different communication modes (such as text, video and audio) and the use of computer-tailoring to convey health information (Middelweerd, Mollee, van der Wal, Brug, & te Velde, 2014). That is, smartphones are in general already partly used for their MP3-function, and smartphone applications can be easily used to include and deliver auditory information, for example as integrated within a health intervention. In addition, there is some evidence that at least audio-visual tailored messages can have advantages compared to text-based tailored messages (Soetens, Vandelanotte, de Vries, & Mummery, 2014; Stanczyk et al., 2014) and at least one study suggests that audio-based information may be of added value in the stimulation of fruit and vegetable consumption (Connell, Goldberg, & Folta, 2001). Furthermore, tailoring can have beneficial effects in health interventions over providing non-tailored information, for example by increasing the relevance of the information (Dijkstra, 2005; Hawkins, Kreuter, Resnicow, Fishbein, & Dijkstra, 2008; Lustria et al., 2013; Oenema, Brug, Dijkstra, de Weerdt, & de Vries, 2008). The goal of the current study is to investigate the efficacy of

a smartphone intervention that delivers tailored persuasive information as communicated via two different communication modes: text versus audio.

The mode of communication via which the persuasive health information is delivered might affect how the information is processed. For instance, compared to textually tailored information, interactive tailored information (either video- or audio-delivered) has been found to lead to greater attention (Alley et al., 2014; Lee, 2011) and is perceived as being more salient (Chaiken & Eagly, 1983) and engaging (Lee, 2011). In addition, in processing video- and audio-delivered communication, source considerations and peripheral cues or heuristics may play a more important role (Pfau, Holbert, Zubric, Pasha, & Lin, 2000). Furthermore, one study showed no significant differences between auditory and textual feedback on the recall of health-related information (Corston & Colman, 1997). Other studies found mixed results between audio-visual and textual feedback (Alley et al., 2014; Corston & Colman, 1997); audio (-visual) information was not always more effective than textual feedback. Thus, concerning the communication of health-related information, no explicit conclusion can be formulated with regard to the efficacy of a specific communicationmode.

The current intervention will apply and compare auditory and textual persuasive communication aimed at stimulating fruit and vegetable intake. A sufficient daily intake of fruit and vegetables contributes to the prevention of cardiovascular diseases and certain types of cancer (WHO, 2002). However, over 70% of the Dutch adult population does not meet the recommended minimum intake of fruit and this percentage is even higher for vegetable consumption (van Rossum, Fransen, Verkaik-Kloosterman, Buurma-Rethans, & Ocké, 2011). These recommendations refer to a daily consumption of two pieces of fruit and two-hundred grams of vegetables for an adult population (Netherlands Nutrition Centre, 2011). In addition, the average intake levels of fruit and vegetables seems to be decreasing over the years (van Rossum et al., 2011). Moreover, similar intake patterns and trends are identified all over the world (Murphy, Barraj, Spungen, Herman, & Randolph, 2014). Thus, the stimulation of fruit and vegetable consumption remains to be a highly important health promotion topic.

To determine which communication mode can be used to deliver the tailored health information most effectively, it is important to test this in a randomized controlled trial. In the current study, two research questions will be central. First, we aim to answer the question whether a tailored health intervention delivered via a smartphone application is able to change fruit and vegetable intake in the advocated direction. Second, the study provides a test of the possible difference in efficacy between the more classic textual mode of communication (reading) and the auditory mode of communication (listening).

With regard to the first research question, it is expected that a tailored health intervention will be more effective compared to a control condition in which no health information is given. However, this difference may not be displayed in everyone, but only

in a specific group of people. It is hypothesized that this will be especially the case in people who perceive a need to change their fruit and vegetable intake. It is reasoned that people who perceive the own health as relatively good do have a lower need to change, whereas this need is higher for people who perceive the own health as relatively poor. The intervention might fit within the need for this latter group, and therefore might be more beneficial for people who perceive the own health as relatively poor. Within the unimodel of persuasion (Kruglanski & Thompson, 1999) this could be described as a match between the persuasive information and a premise held by a person (e.g., 'I might need this information because my health is not that good), whereas this match might be lacking for people who perceive the own health as good in advance. Therefore, we will test the hypothesis that the intervention (either textual or auditory) will be more effective, especially for people who perceive the own health as relatively poor.

With regard to the second research question, it will be investigated whether the efficacy of the auditory intervention differs from the textual intervention. Again, this might not be the case for everyone. A relevant individual difference in this context is health literacy, defined as "the degree to which individuals can obtain, process, and understand the basic health information and services they need to make appropriate health decisions" (Institute of Medicine, 2004). Furthermore, health literacy is found to be related to level of education, cognitive and social skills, language and cultural barriers, and motivation (Institute of Medicine, 2004; Santo, Laizner, & Shohet, 2005) and low health literacy is associated with poorer health outcomes as well (Mõttus et al., 2014; Norman & Skinner, 2006). It seems worthwhile to consider the communication modality in combination with the construct of health literacy (Norman & Skinner, 2006). For instance, it is recommended to explore the use of auditory information as this might be especially beneficial for people with low health literacy (Santo et al., 2005). Therefore, it is expected that people with low health literacy may benefit from health information as communicated via the auditory mode, whereas no specific differences are expected for people with high health literacy.

In sum, we aim to test the efficacy of two different fruit and vegetable promotion interventions delivered via a smartphone application that communicate persuasive health information via the auditory or textual mode. The efficacy of the auditory and textual intervention will be compared to a control condition in which no intervention is present, and the textual and auditory intervention will be compared to each other. The content of the intervention is tailored to relevant characteristics of the individual: Feedback on the perceived own fruit and vegetable consumption and personalized recommendations regarding the individual barriers to eat sufficient fruit and vegetables are included. Other evidence-based behavior change strategies (Abraham & Michie, 2008) applied in this intervention to assist behavior change are listed in Table 8.1. The dependent variables are self-reported fruit intake and self-reported vegetable intake at six-month follow-up as

assessed with a detailed and validated frequency questionnaire (Bogers, van Assema, Kester, Westerterp, & Dagnelie, 2004).

Table 8.1 Overview of behavior change techniques applied in the current intervention ▼

Behavior change technique	*Example*
Tailored working mechanisms	
Provide feedback on performance	'You indicate that you eat sufficient fruit and vegetables, that is very positive' (baseline message)
Adaptation of the content	Provide information on how to overcome personal barriers; the inclusion of information about weight management, based on dieting status (baseline message)
Preference tailoring	Use of preferred conversational form throughout the intervention
Testimonial matching	Respondents were generally exposed to a testimonial of the same gender as themselves (follow-up moments)
General working mechanisms	
Provide information about behavior - health link	Provide general health risk information: 'Eating sufficient fruit and vegetables contributes to a good health' (baseline message)
Provide information on consequences	Provide positive outcomes of performing the behavior: 'The vitamins, minerals and fibers in fruit and vegetables affect your health in several ways (low blood pressure, improved physical stamina and decreased risk for diseases; baseline message)

Barrier identification	'Different aspects can play a role in eating insufficient fruit / vegetables. Of the following reasons can you list maximally two aspects that apply to you?' (assessed at baseline)
Use of follow-up prompts	Monthly follow-up moments are created to encourage respondents to re-visit the application
Provide opportunities for social comparison	The use of testimonials (follow-up moments)
Prompt specific goal setting	Respondents are encouraged to create own implementation intentions (general application content; menu button 'action plan')
Repetition	Respondents can be exposed to the tailored message multiple times (general application content; menu button 'my advice')

Method

Recruitment. Participants were recruited in October and November 2013 to join a smartphone intervention study aimed at stimulating fruit and vegetable intake. Those interested were eligible for participation if they were 16 years or older, lived in the Netherlands and owned an Android device (smartphone or tablet, Android version 2.2 or more) with an installed version of Adobe Air (if necessary, they were automatically directed to Google Play to install it safely)[1]. In addition, the invitation in the recruitment was specifically aimed at people who did not (yet) succeed in consuming two pieces of fruit and 200 grams of vegetables on a daily basis. After the two-month recruitment period, interested people who signed up could not participate anymore.

[1] In collaboration with the programmers, we decided to focus solely on the Android operating system, as market research shows that the majority of the Dutch smartphone users owns an Android device (TNS NIPO, 2011).

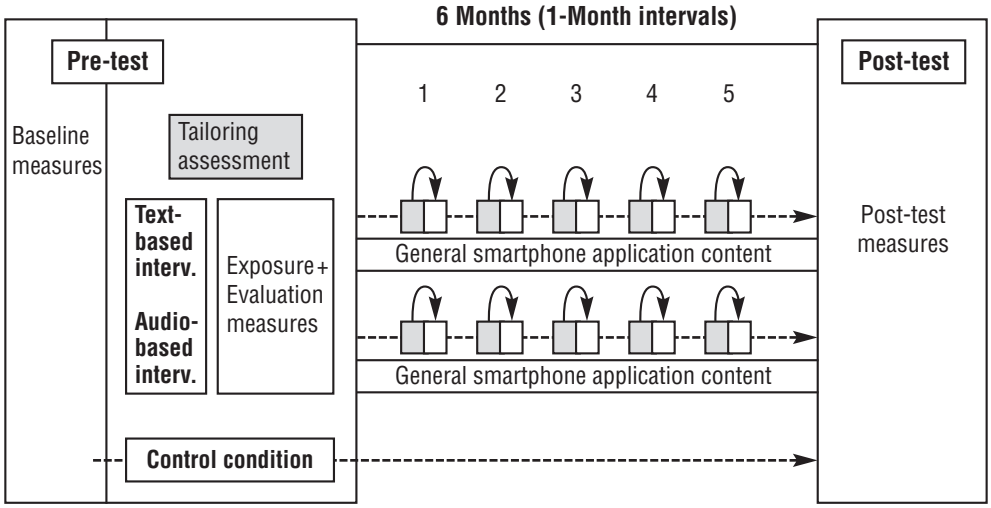
Participants were recruited via several advertising campaigns as published on newspaper and (health) magazine websites, on the local university website, in the newsletter of the Netherlands Nutrition Centre and via social networking websites. In addition, a local newspaper focused on the topic of fruit and vegetable consumption and referred to our smartphone application, the "Fruit and Vegetables hAPP" (the addition of the 'h' to the word 'app' means in Dutch 'snack' or 'bite'). All advertisements briefly mentioned the content and six-month duration of the study and provided a link to the smartphone application in Google Play where respondents could find more information and download it. Respondents were not informed on the existence of research conditions. They had a chance of winning different prizes (two Android tablet computers, ten books with vegetable recipes and twenty € 10 coupons) after completing the pre-test and post-test measurements. The study was approved by the ethical committee of the local faculty of Behavioral and Social Sciences for conducting human participants research (nr. 13012-N, trial registration: ISRCTN23466915).

We estimated the number of respondents to be included. The current intervention and the comparison between auditory and textual persuasion are novel so it is hard to predict what can be expected, but we aim to find medium effects for the intervention to be of practical relevance. This means at least 64 respondents need to be included in each condition at post-test (*p* set on .05, power .80; Soper, n.d).

Research design and procedure. The current study was a pre-test – post-test randomized controlled trial with two experimental conditions (text-based tailored health information and audio-based tailored health information) and a control condition in which respondents completed only the baseline measurements and post-test measurements at six-month follow-up. Those interested could download the smartphone application in Google Play and sign up for the research via the application itself. This was done by creating a personal log-in and account with an email address and password, which was necessary to combine the data of the different measurements. In addition, the sign-up procedure consisted of questions on gender, first name and preferred conversation form[2]. This information was used for tailoring purposes throughout the assessment and intervention. Next, respondents were presented with an informed consent form that stated the procedure, duration and confidentiality of the research. After giving informed consent in the smartphone application, respondents were automatically assigned to one of the three conditions (sequentially, in order of registration). All assessment questions (one question per screen) and the tailored health information were delivered via the smartphone application. Figure 8.1 represents an overview of the design and the different elements of the study, which will be described below.

[2] In Dutch, a formal and polite conversation form (u, uw) and a more informal conversation form can be distinguished (*jij, jou*).

Figure 8.1 The design of the smartphone health intervention to stimulate fruit and vegetable intake ▼



Respondents in all conditions were asked to complete the pre-test measures that consisted of baseline measures and questions for tailoring purposes. Respondents in the text-based and audio-based health information condition were then exposed to a tailored message (on the basis of decision rules) and additional evaluation measures. In total, this first contact took 20 minutes on average after which these respondents had access to the general smartphone application content. Respondents in the control condition were only exposed to a message screen addressing the end of the baseline questionnaire. They were thanked for their participation and it was explicitly mentioned that they could expect another questionnaire six months later. They did not have access to the content of the smartphone application.

Those respondents who did not complete the baseline questionnaire within one month were reminded by email to fill out the questionnaire. Further reminders were sent monthly; respondents who did not complete it during the research period were excluded from the study and informed about this by email.

In the months in-between pre-test and post-test assessment, respondents in the text-based and audio-based health information condition received monthly email invitations (with a maximum of four reminders during the month). They were asked to visit the smartphone application to complete follow-up tailoring measures (identical for each month) and were exposed to newly added (either textual or auditory) tailored health information based on their input. Finally, at 6-month follow-up, all respondents were sent an email invitation to fill out the post-test measures in the smartphone application (again with a maximum of four reminders during the month). Respondents who indicated they

were interested in receiving more information were debriefed via email when the 6-month post-test had been completed. For ethical reasons, respondents could notify the researchers during the trial when they were not interested in participating anymore. After this notification, they did not receive monthly email invitations anymore, but only a final invitation to complete the post-test measures.

Intervention. The experimental studies as presented in the current thesis helped to shape the current intervention that was developed in the perspective of Intervention Mapping (Bartholomew, Parcel, & Kok, 1998; Bartholomew, Parcel, Kok, Gottlieb, & Fernández, 2011; Kok, Schaalma, Ruiter, van Empelen, & Brug, 2004). The intervention is based on several social-cognitive determinants that are known to predict fruit and vegetable intake (Bandura, 1998). The core determinants include outcome expectations of eating sufficient fruit and vegetables and self-efficacy with regard to being able to eat sufficient fruit and vegetables. More specifically, the intervention focused on increasing positive outcome expectations and restructuring negative outcome expectations with regard to eating sufficient fruit and vegetables, and increasing self-efficacy. Different methods are used to address these factors. For instance, to target self-efficacy we identified the respondents' experienced barriers to eat sufficient fruit and vegetables and provided relevant information to cope with these barriers (Abraham & Michie, 2008).

The intervention consisted of one main moment of exposure to the tailored information at baseline and five follow-up moments with exposure to smaller components of tailored information. After exposure to the main tailored message right after completing the pre-test measurements, respondents had access to additional functions of the smartphone application throughout the six months. These functions were presented as seven main menu buttons (Figure 8.2a), including a button where respondents were invited to formulate a personal action plan while making use of if…then formulations (implementation intentions; Figure 8.2b), a button with an alphabetical list of fruit and vegetables (Figure 8.2c) and fruit and vegetable recipes. Four extra recipes were uploaded to the smartphone application every month. In addition, one button included the most recent tailored message, in order to make it possible to read or listen to it again (Figure 8.2d).

Figure 8.2 Screenshots of the application content: a) main menu; b) action plan; c) alphabetical list of fruit and vegetables; d) tailored auditory advice. Screenshots a, b, d are translated from Dutch ▼

During the five follow-up moments in-between the pre-test and post-test assessment, respondents were each month exposed to a new, short tailored message that approached the topic of fruit and vegetable intake from distinct perspectives. Every month, the content was related to a general topic: The effect on well-being, the availability of fruit and vegetables, fruit and vegetables as a basic physical need, the lowered risk for chronic diseases, fruit and vegetable intake as a part of a healthy lifestyle, and objections people can have regarding fruit and vegetable intake, respectively. Additionally, a unique testimonial was included each month for sharing experiences on fruit and vegetable intake with the respondents. Testimonials are constructed stories in which successful personal experiences are shared to 'directly or indirectly encourage the audience' to perform the behavior themselves (Braverman, 2008). For example, a physician elaborated on the relevance of a healthy diet and a non-expert (without a specified occupation) expressed the experienced benefits of fruit and vegetables on the long term. To ensure that respondents were exposed to the information from different perspectives, the follow-up content was replaced in the smartphone application at all five follow-up moments.

• *The main tailored message.* At baseline, a number of tailoring questions were included to partly determine the content of the feedback. Firstly, respondents could indicate with two questions whether their fruit and vegetable consumption is sufficient or not (perceived (subjective) consumption of fruit and vegetables, respectively), according to the recommendations. Participants could answer these questions with 'Yes, I do meet this guideline', 'No, I probably do not always meet this guideline' and 'No, I do not meet this guideline'. The second category was added to prevent people to over report their fruit and vegetable intake; the latter two answering options both reflected 'not meeting the guideline'.

Based on the answers given, respondents could select one or two individual barriers to eat sufficient fruit and / or vegetables from a predefined list. Respondents who indicated that they already met the guideline of eating sufficient fruit and vegetable consumption were asked to think of barriers in a future period in which they possibly would eat less fruit or / and vegetables. Examples of barriers included in the list were 'I don't like the taste of fruit' or 'It takes a lot of time and effort to prepare vegetables' (see also Brug, Lechner, & de Vries, 1995; Springvloet, Lechner, & Oenema, 2014).

Another tailoring question concerned health value, as assessed with one item ('How important is health to you?'). Participants could indicate whether they believed health is 'most important to them' [2] or not ('It is important to me, but not the most important aspect in life' [1]). In addition, they could indicate the perceived difference between themselves and their ideal and ought self, respectively ('In general, how large is the difference between who you actual are and who you prefer to be / who you should be?'). A scale was created by subtracting the score on the second item from the score

on the first item; answering options ranged from 'very small' [1] to 'very large' [7]. The combination of health value and self-discrepancy determined whether the baseline message focused on the positive outcomes of sufficient fruit and vegetable consumption or on the negative outcomes of insufficient fruit and vegetable consumption (Dijkstra, Schakenraad, Menninga, Buunk, & Siero, 2009). Finally, it was assessed whether respondents were frequent dieters (with answering options never [1], sometimes [2], regularly [3], often [4], based on Lowe & Timko, 2004), and whether they had a partner relationship or not. These answers were used to decide whether or not to include information on the outcomes of (in)sufficient fruit and vegetable consumption related to weight management and appearance benefits, respectively.

Based on the answers on the above-mentioned tailoring questions, the baseline message consisted of a short general introduction providing information on the behavior - health link, feedback on the own fruit and vegetable consumption, and adapted information on the outcomes of (in)sufficient fruit and vegetable consumption with possibly, information about appearance benefits and weight management. Then, feedback regarding one or two assessed individual barriers to perform the behavior with personal recommendations and formulation of relevant individual implementation intentions (Adriaanse, Vinkers, de Ridder, Hox, & de Wit, 2011; Chapman, Armitage, & Norman, 2009; Gollwitzer & Sheeran, 2006) were included. Throughout the smartphone application, the preferred conversation form 2 was used consistently. Transition sentences and closing sentences were created to ensure that the composed message was perceived as one fluent message (see Appendix 2, QR-code 10, for an example of a composed auditory health message at baseline).

• *The follow-up tailored messages.* During all follow-up moments, respondents had to answer maximally four tailoring questions. First, the two questions on the current self-perceived fruit and vegetable intake were assessed again. The recommendations were included and respondents could indicate whether they met this guideline in the previous two weeks (answering options 'Yes' / 'Almost' / 'No'; the latter two answering options were considered as 'not meeting the guideline'). In case of insufficient self-perceived fruit and/or vegetable consumption, we additionally asked whether the respondent had the intention to increase fruit and/or vegetable consumption in the following two weeks (answering options 'No / 'A little' / 'Yes'; the first two options reflected 'no intention').

Based on the given answers, respondents were then exposed to a short (textual or auditory) feedback message that addressed a certain theme at each follow-up moment. After this, the (textual or auditory) testimonial was included that matched the respondent's own gender, except when it was one of the three testimonials that was only recorded with either a male or a female voice. This was decided in line with general expectations; for example, a dietician was only represented by a female voice.

Respondents who already perceived their fruit and vegetable consumption as sufficient were not exposed to the thematic information, but only to a short encouraging message and testimonial.

• ***Mode of delivery.*** The text-based and audio-based interventions varied only in their mode of delivery. The content information was partly composed in collaboration with the Netherlands Nutrition Centre and the auditory elements were developed in collaboration with a professional recording studio. An experienced female actress was selected for recording the baseline and follow-up feedback messages. She had a gender-congruent voice (feminine and high-pitched) and neutral sound without specific cultural or disturbing elements. After recording and arrangement sessions, the tailored audio-files (233 files for the pre-test and 114 for the follow-up moments, ranging from a single sentence to a text of 200 words) were mastered in 96 kHz 24 bit and converted to mono MP3 format (64 kbps) to use in the smartphone application. As it was important that the audio files of different parts could be arranged into one fluent message (without experiencing obvious transitions between parts), it was ensured that all recordings had a similar 'tone-of-voice'. Natural pauses between sentences lasted approximately one second; after every part, a one-second pause was created as well to create natural transitions as good as possible. After a first evaluation round, the recording studio made some improvements and once the first author approved this, the audio files could be uploaded in the intervention system by the programmers. Before listening to the baseline message, respondents in the audio-based information condition were presented with an instructive recording on volume regulation. They could adjust the smartphone volume while listening, to ascertain that it was sufficient and convenient. On the next screen, they could listen to the tailored health message. The complete message at baseline consisted on average of about 900 words (approximately five minutes for the auditory recording), roughly varying between 600 words (approximately three minutes) and 1200 words (approximately six minutes). In addition, the shorter tailored messages at follow-up consisted on average of 180 words and lasted 1:10 minutes on average for the auditory recording.

Contrary to the other auditory content, the testimonials within the follow-up moments were recorded with non-professional voices. The first author gave instructions and the testimonials were recorded in an office environment with a headphone microphone with the software program 'Praat' (Boersma & Weenink, 2000) and arranged with the software program 'Audacity' (Audacity Team, 2012). The recordings were send to the professional recording studio to make sure that the testimonials had the same quality and default volume as the remaining auditory content, again to ensure that it could be composed together. In total, 11 expert and non-expert testimonials were created, among which four were recorded twice; that is, with a male and female voice. Three testimonials were only recorded for a man or a woman. On average, the testimonials

consisted of 244 words and lasted 73 seconds. In total, an average follow-up moment lasted two to three minutes.

Measurements • *Baseline measurement.* The following socio-demographic variables were assessed: age, cultural background and highest level of completed education. This latter item was dichotomized into low (primary education, lower general secondary education, intermediate vocational education) and high level of completed education (higher general secondary education, higher vocational education, university level). Then, health-related questions were asked. The perceived own health (based on CBS, 2013) could be indicated on a six-point scale ranging from ("my health is…") 'very good' [1] to 'very bad' [6]. This item was recoded and high scores corresponded with good perceived health (M = 4.86, SD = .72). Self-reported height and weight were assessed to calculate body mass index (BMI) and we assessed whether respondents were having a chronic disease or dyslexia. In addition, two items assessed perceived difficulty of eating sufficient fruit and sufficient vegetables as a measure of self-efficacy: "How difficult is it for you to eat sufficient fruit (vegetables)"? Both items could be answered on five-point scales ('not difficult at all' [1] / 'not difficult' [2] / 'neutral' [3] / 'difficult' [4] / 'very difficult' [5]). A composite measurement was created (r = .37, p < .001; M = 2.47, SD = .95).

Then, we assessed the self-reported fruit and vegetable consumption in the previous month with a detailed and validated food-frequency-questionnaire (Bogers et al., 2004). Respondents were asked how often on average per week they ate or drank products from several fruit and vegetable categories during the previous month. The answer options ranged from 'never or less than 1 day a week' [0], '1 day a week' [1] to 'every day' [7]. Next, they were asked to indicate the amount of intake per category of fruit or vegetables in terms of pieces of fruit and servings of vegetables, with the answering options ranging from 'none' [0], 'one piece' [1] to 'five or more pieces' [5]. The main categories were 'cooked vegetables', 'raw vegetables / salad', 'fruit and vegetable juice', 'tangerines', 'oranges / grapefruits / lemons', 'apples / pears', 'bananas', 'other fruit' and 'apple sauce'. The category 'fruit and vegetable juice' was excluded as it made us unable to distinguish between fruit and vegetables. The number of days per week and the vegetable portions were multiplied for the first two categories and added to create a composite index of average weekly vegetable intake of the previous month. The average number of days per week and the fruit portions were multiplied for the remaining six categories and added to create a composite index of weekly fruit intake of the previous month.

Finally, we assessed respondents' health literacy with three statements that could be answered on five-point scales ranging from 'strongly disagree' [1] to 'strongly agree' [5]. The three items were: 'I think it is easy to understand… information about health and lifestyle' / '…health information given by a physician, for example about a

disease or treatment' / '…information about the effects of healthy nutrition' (α = .85, *M* = 4.23, *SD* = .77).

Process evaluation questions were included immediately after respondents in one of the two experimental conditions had been exposed to the tailored health information. These items were included to assess self-reported exposure ('Did you read / listen to the fragment?', answering options ranging from 'Yes, completely' [1] to 'No, not at all' [5]) and potential distracting elements while reading or listening ('Was the reading or listening possibly disrupted, for example by other people, hard sounds, music or other distracting elements?', with answering options 'yes' and 'no'). In addition, the novelty and usefulness of the information were assessed with two statements ('The information was new to me / useful for me') that could be answered on a five-point scale ranging from 'strongly disagree' [1] to 'strongly agree' [5]. Finally, a general evaluation question was included ('How would you rate the intervention?'). This item could be answered on a seven-point scale ranging from 'very negative' [1] to 'very positive' [7].

• ***Post-test measurement.*** At 6-month follow-up, fruit and vegetable intake was again assessed with the same questionnaire as at baseline (Bogers et al., 2004). Again, two composite measures for respectively fruit and vegetable consumption were created. In addition, it was assessed how often respondents searched for information about health and fruit and vegetables besides the information in the smartphone application (*M* = 3.03, *SD* = 1.03), and to what extent they spoke to others about the topic in the past six months (*M* = 2.71, *SD* = 1.08). Both items could be answered on five-point scales with answering options ranging from 'never' [1] to 'often' [5]. Finally, seven questions were added to evaluate the information and smartphone application as a whole on a range of measures, such as personal applicability, novelty, credibility, the extent to which it is perceived as intense, usefulness, comprehensibility and visual attractiveness. These questions could be answered on five-point scales, with answering options ranging from 'strongly disagree' [1] to 'strongly agree' [5]. In addition, one item provided recipients with the opportunity to give qualitative feedback.

Results

Sample characteristics. In total, 342 respondents registered for the study and started the pre-test measurement, of whom 96.5% completed it (*n* = 330). Of these 330 respondents, 44.5% completed the final questionnaire at six-month follow-up as well.[3] One respondent was excluded because of reporting being intolerant for fruit. The final sample for the analyses consisted of 146 respondents, of whom 73% females, 71% high educated, varying in age from 16 to 71 years (*M* = 41.4, *SD* = 14.6) with a mean

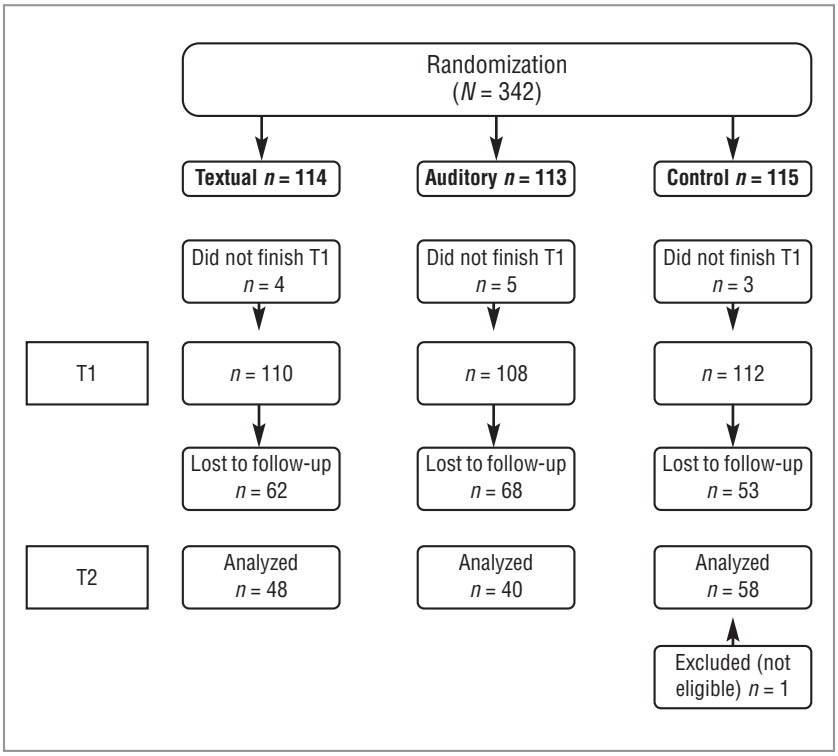
[3] Thirty respondents (9%) were accidentally exposed to the same information during the first two follow-up moments (for technological reasons), instead of being exposed to different content information.

BMI of 25.2 (*SD* = 5.5). Recipients with a lower education reported a lower health literacy (*M* = 4.01, *SD* = .77), compared to recipients with a high education (*M* = 4.32, *SD* = .76, $p < .05$).

The composite index of fruit and vegetable intake at pre-test was treated as an objective indication of fruit and vegetable intake. The mean fruit intake was sufficient (14 portions is considered sufficient; scale ranging from 0 to 56; *M* = 14.04, *SD* = 10.63), whereas the mean vegetable intake was insufficient (28 portions is considered sufficient; scale ranging from 6 to 70; *M* = 25.44, *SD* = 11.37)[4]. Based on the answers given, 19.2% of the respondents was classified as consuming an insufficient amount of vegetables (but a sufficient amount of fruit), 16.4% was classified as consuming an insufficient amount of fruit (but a sufficient amount of vegetables), 48.6% was classified as consuming both insufficient amounts of fruit and vegetables, and 15.8% was classified as consuming sufficient amounts of both fruit and vegetables. At post-test, the scores on the composite index of fruit and vegetable intake were somewhat higher (fruit; scale ranging from 1 to 56.5; *M* = 14.93, *SD* = 9.27 and vegetables; scale ranging from 6 to 70; *M* = 27.47, *SD* = 11.81). The respondents were distributed over the conditions as follows: Textual health information (*n* = 48); auditory health information (*n* = 40); control condition (*n* = 58). Figure 8.3 represents a flowchart in which the drop-out rates per condition are depicted.

[4] If one of the two questions was answered with zero ('never or less than 1 day a week' or 'no servings'), the total intake for that specific category was automatically set at zero as well (also when the pattern was not filled in consistently). This conservative approach means that the fruit and vegetable intake might be somewhat lower than in reality. Condition did not affect whether a question on fruit or vegetable intake was filled in consistently or not at baseline ($p = .66$) or post-test ($p = .64$).

Figure 8.3 Flowchart of number of participants allocated per condition ▼



Randomization check and attrition analyses. Univariate analyses (ANOVA, Chi-square) were conducted to analyze whether the respondents in the conditions differed on relevant pre-test measures. No significant differences between conditions were found regarding our set of 18 demographic and health-related baseline variables: gender (p = .53), age (p = .11), highest completed education (p = .35), cultural background (p = .75), dieting status (p = .09), relationship status (p = .41), the extent to which health is valued (p = .25), discrepancy between ought and ideal self (p = .54), having dyslexia (p = .94), perceived own health status (p = .78), having a chronic disease (p = .84), BMI (p = .30), self-efficacy (p = .72), self-reported (objective) fruit consumption (p = .79), self-reported (objective) vegetable consumption (p = .16), perceived (subjective) fruit and vegetable consumption (p = .86 and p = .37, respectively), and health literacy (p = .07).

In addition, it was investigated whether the respondents who dropped out after baseline (n = 184, 53.2 %) significantly differed from the respondents who completed both measurements. The groups did not significantly differ on the same pre-test measures as mentioned in the previous paragraph (ps > .12). Furthermore, condition

did not significantly affect whether respondents dropped out during the trial (p = .08). However, respondents who completed the study and who received either the auditory or textual feedback, reported a significantly higher extent of being exposed to the information (p < .001) and they had a slightly more positive general impression of the pre-test intervention content and measures compared to those who dropped out (p = .06). Finally, when exposed to the auditory feedback, respondents who dropped out reported being distracted while listening to the baseline intervention content more often compared to those who completed the whole study, p < .05. No significant differences were found on the extent to which the information was perceived as new or useful.

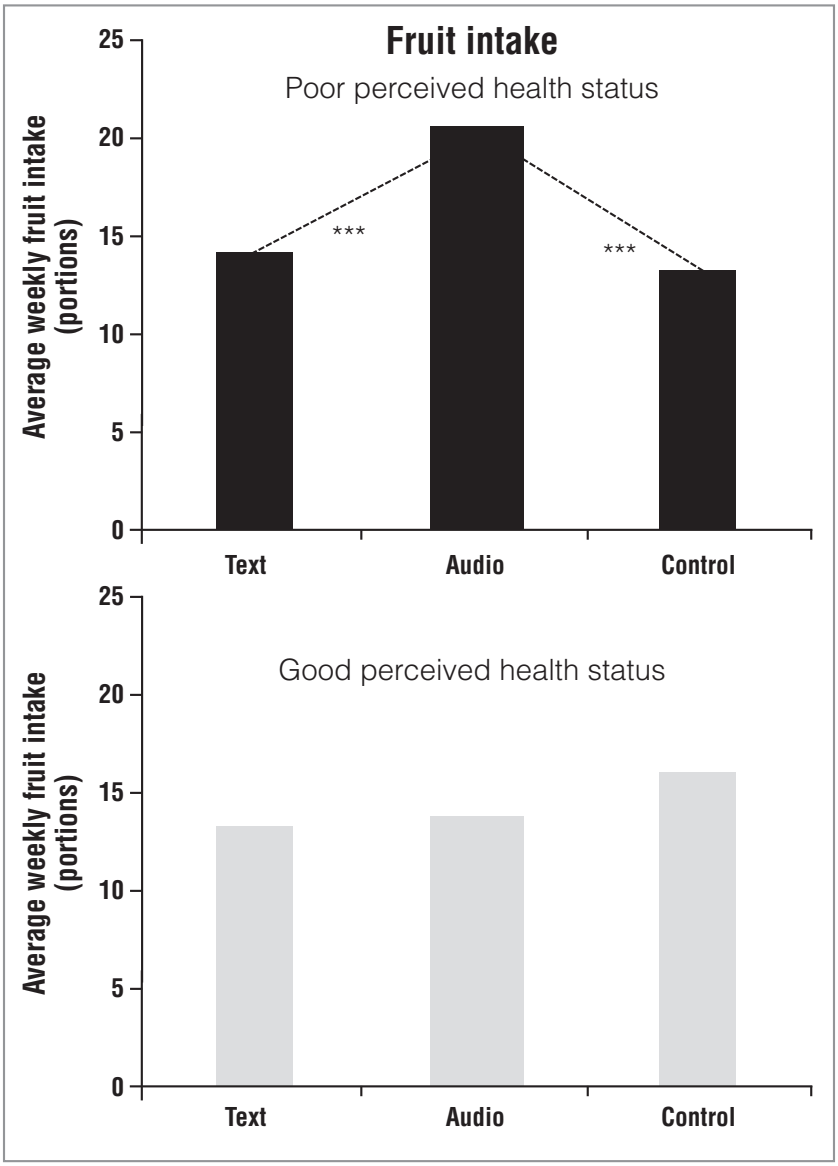
Effects on fruit and vegetable consumption • *Main effects.* In all subsequent analyses on behavior, ANCOVAs were conducted for fruit and vegetable intake separately. Self-reported fruit or vegetable intake at baseline was included as a covariate, as well as age and highest completed education, since these two variables had a large variance within this community sample. First, we assessed whether condition affected the self-reported intake of fruit and vegetables six months after baseline. With regard to fruit intake, a significant main effect was found; $F(2, 140) = 3.08$, $p < .05$, $\eta_p^2 = .04$ with the following estimated means: text (M = 13.5, SE = 1.05), audio (M = 17.1, SE = 1.18) and control (M = 14.3, SE = .95). The difference between text and audio was significant (p = .018), and between audio and control it was marginally significant (p = .064). The difference between text and control was not significant (p = .53). No significant main effect was found on vegetable intake; $F(2, 140) < 1$, $p = .99$, $\eta_p^2 = .00$.

For fruit consumption, the raw means at pre-test and post-test were inspected to gain more insight into the actual differences per condition. The means remained quite similar in the textual feedback condition: $M_{pre\text{-}test}$ = 14.8 (SD = 11.1) vs. $M_{post\text{-}test}$ = 14.2 (SD = 6.9) and in the control condition: $M_{pre\text{-}test}$ = 13.4 (SD = 10.4) vs. $M_{post\text{-}test}$ = 13.8 (SD = 9.4). Thus, only small differences were observed here (- 0.6 pieces and + 0.4 pieces on average per week, respectively). In the auditory feedback condition, the fruit intake was most strongly increased (+ 3.3 pieces; $M_{pre\text{-}test}$ = 14.2 (SD = 10.6) vs. $M_{post\text{-}test}$ = 17.5 (SD = 11.1)).

• ***Moderation effects.*** We assessed whether the effects of condition were similar in specific groups of respondents. Perceived own health status and health literacy were tested as moderators on fruit and vegetable consumption. First, a significant interaction was found between condition and perceived own health status on fruit intake; $F(2, 137) = 4.24$, $p < .05$, $\eta_p^2 = .06$, but not on vegetable intake; $F(2, 137) < 1$, $p = .86$, $\eta_p^2 = .00$. To further examine the meaning of this effect on fruit intake, simple main analyses were conducted at two different levels (low / high) of the moderator. The complete dataset was used to model respondents as scoring high or low, by adding and subtracting one standard deviation to the standardized means, respectively (Cohen, Cohen, West,

& Aiken, 2003). Figure 8.4 displays the mean fruit consumption for respondents with a poor and good perceived own health.

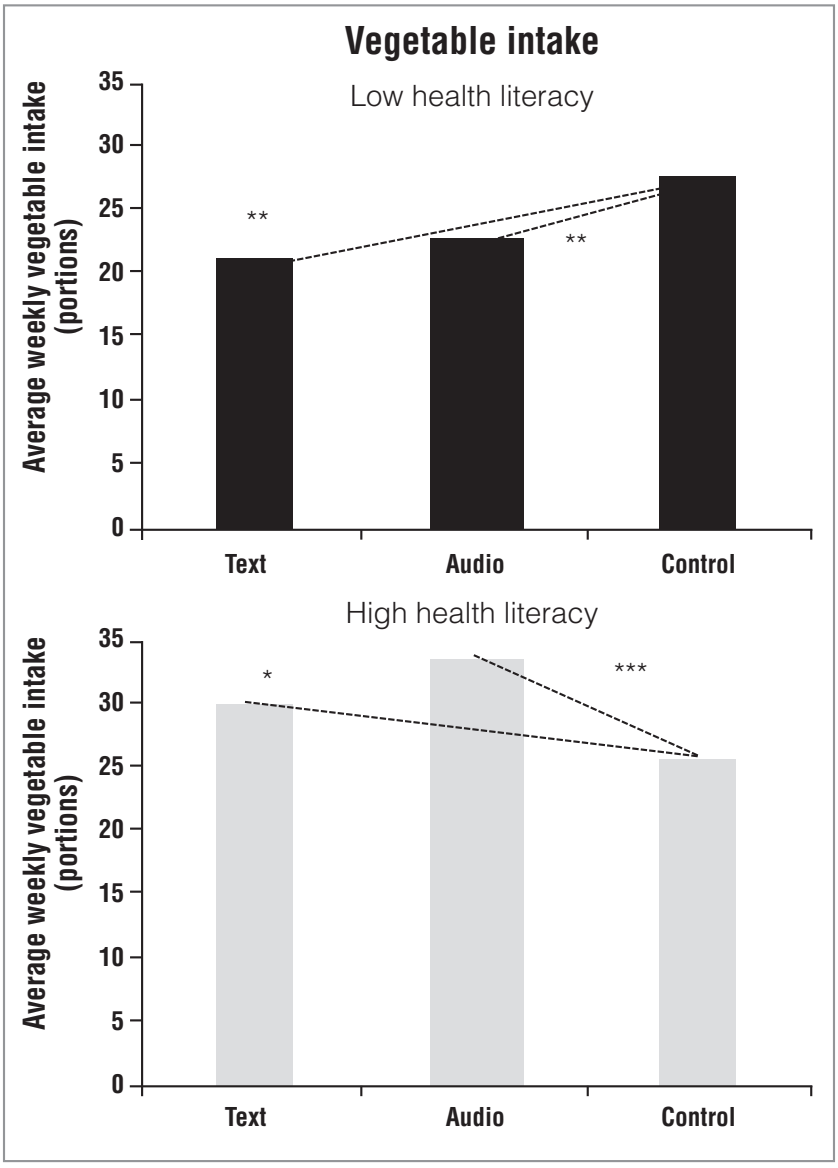
Figure 8.4 The interaction between condition and perceived own health status on fruit consumption at six-month follow-up *** $p < .01$ ▼



In case of poor perceived own health status, condition did significantly affect fruit consumption at six-month follow-up; $F(2, 137) = 6.05$, $p < .01$, $\eta_p^2 = .08$. The mean scores were as follows: text ($M = 14.2$), audio ($M = 20.5$) and control ($M = 13.2$). Post-hoc contrasts showed that the intake of fruit was significantly higher after listening to the information compared to the other two conditions ($ps < .01$). In case of good perceived own health status, condition had no significant effect; $F(2, 137) = 1.15$, $p = .32$, $\eta_p^2 = .02$. The mean scores were as follows: text ($M = 13.3$), audio ($M = 13.8$) and control ($M = 15.9$). No significant contrasts were found.

Second, health literacy as assessed at pre-test was tested as a moderator. No significant interaction with condition was found on fruit intake; $F(2, 137) < 1$, $p = .78$, $\eta_p^2 = .00$. However, we found a significant interaction on vegetable intake; $F(2, 137) = 8.42$, $p < .001$, $\eta_p^2 = .11$. We examined the meaning of this effect by applying the same procedure as mentioned above (Cohen et al., 2003). Figure 8.5 displays the mean vegetable intake in the conditions for people with relatively low and high health literacy.

Figure 8.5 The interaction between condition and health literacy on vegetable consumption at six-month follow-up. * $p < .10$, ** $p < .05$, *** $p < .01$ ▼



In case of low health literacy, condition significantly affected vegetable consumption at six-month follow-up; $F(2, 137) = 3.62$, $p < .05$, $\eta_p^2 = .05$. The mean scores were as follows: text ($M = 21.3$), audio ($M = 23.1$) and control ($M = 27.9$). Post-hoc contrasts showed that the intake of vegetables in this group was significantly higher in the control condition compared to the two interventions (ps < .05). In case of high health literacy, condition significantly affected vegetable consumption at six-month follow-up as well; $F(2, 137) = 4.53$, $p < .05$, $\eta_p^2 = .06$. The mean scores were as follows: text ($M = 30.1$), audio ($M = 33.5$) and control ($M = 25.6$). Besides the higher scores compared to respondents with low health literacy, post-hoc contrasts showed that the intake of vegetables in this group was lower in the control condition compared to the textual intervention ($p = .07$) and the auditory intervention ($p = .004$)[5].

We further analyzed the effects in selections of respondents for whom the health information could be especially relevant. With regard to the effects on fruit intake, respondents were selected whose objective fruit intake was found to be insufficient (and the objective vegetable intake was either insufficient or sufficient, $n = 95$). The main effect on fruit consumption was not significant anymore; $F(2, 89) = 1.85$, $p = .16$, $\eta_p^2 = .04$. The estimated means are lower, showing a similar pattern: text ($M = 11.2$, $SE = 1.12$), audio ($M = 13.7$, $SE = 1.25$) and control ($M = 10.9$, $SE = 1.00$). Only the difference between audio and control was marginally significant ($p = .07$). This pattern was again especially found within recipients with a poor perceived own health (moderation effect; $F(2, 86) = 2.46$, $p < .10$, $\eta_p^2 = .05$ with a significant main effect of condition in this specific group; $F(2, 86) = 3.95$, $p < .05$, $\eta_p^2 = .08$), showing significant differences between control ($M = 8.9$) and audio ($M = 16.3$; $p = .006$) and text ($M = 10.5$) and audio ($p < .05$). No significant differences between the conditions were found for recipients who perceived the own health as relatively good. As in the whole sample, health literacy did not moderate the effect on fruit intake.

In addition, the effects on vegetable intake were analyzed in a selection of respondents who indicated eating insufficient vegetables on forehand (and either insufficient or sufficient fruit intake, $n = 99$). As in the whole sample, no significant main effect or moderation of perceived own health was found. The moderation of health literacy was however not significant anymore; $F(2, 90) < 1$, $p = .93$.

[5] The main effect of condition was not significant on a composite measure of fruit and vegetable consumption ($p = .34$), neither was the interaction with perceived own health status ($p = .16$). However, the interaction with health literacy was; $F(2, 137) = 4.39$, $p < .05$, $\eta_p^2 = .06$. The main effect of condition becomes then non-significant in respondents with low health literacy and only two of the four contrasts remain significant, showing that the control condition was most effective for low-literate respondents (compared to reading) and listening to the auditory information was most effective in high-literate respondents (compared to control).

Intention to treat analyses. At T2, 183 of the 330 (55.5 %) respondents had dropped out despite reminders to fill in the follow-up measurement. In the intention to treat analyses, the post-test (T2) fruit and vegetable intake of these respondents was considered to be equal to their reported fruit and vegetable intake at pre-test. With these data, we again conducted the analyses on fruit consumption and vegetable consumption as reported above. The main effect on fruit consumption remained significant; $F(2, 323) = 3.18$, $p < .05$, $\eta_p^2 = .02$ with the following means: text ($M = 13.5$, $SE = .52$), audio ($M = 15.3$, $SE = .52$) and control ($M = 14.3$, $SE = .51$). Now, the interaction between condition and perceived health status on fruit consumption was not significant anymore ($p = .33$). However, as expected, within respondents with a poor perceived health status, the effect of condition remained significant, $p < .05$, $\eta_p^2 = .02$ with a similar pattern of means and significant contrasts ($ps < .05$) compared to the original analyses. The interaction between condition and health literacy on vegetable consumption remained significant as well; $F(2, 320) = 5.52$, $p < .01$, $\eta_p^2 = .03$. Both within respondents with a low and a high health literacy, the effect of condition became marginally significant with only the contrasts between audio-based health information and the control condition being significant at $p < .05$. Overall, small(er) effect sizes were found.

Process analyses. Besides the above reported effects of the intervention on fruit and vegetable intake, the effects on two categories of process variables were inspected. These process measures are related to exposure to the intervention and a general evaluation with regard to the main tailored message at baseline and the intervention as a whole. When testing the differences between conditions, age and education were applied as covariates, as in the analyses on fruit and vegetable intake.

First, with regard to exposure, participants logged in 7.6 times on average ($SD = 4.5$) and, as expected, this was significantly more in one of the experimental conditions (text-based: $M = 10.1$, $SD = 3.7$, audio-based: $M = 9.4$, $SD = 4.2$) compared to the control condition ($M = 4.2$, $SD = 3.0$, contrasts $p < .001$, $F(2, 143) = 42.11$, $p < .001$, $\eta_p^2 = .37$). No significant difference was found between the two interventions ($p = .35$).

On average, respondents completed 4.1 follow-up moment ($SD = 1.36$). There was a marginally significant difference between the two interventions: After reading, recipients completed slightly more follow-up moments ($M = 4.35$, $SD = 1.19$) compared to the recipients who listened to the information ($M = 3.83$, $SD = 1.50$), $F(1, 86) = 3.40$, $p = .069$, $\eta_p^2 = .04$. In addition, 62.5 % of the 88 respondents in one of the experimental conditions completed all five follow-up moments and at least two follow-up moments were completed by 95 % of the respondents. Those respondents who completed four or five follow-up moments were selected (text: $n = 39$ and audio: $n = 25$) and compared to the control group ($n = 58$) with regard to the set of 18 baseline measures. The groups did not differ significantly from each other regarding these variables ($ps > .05$).

At baseline, respondents who were in one of the intervention conditions were asked to indicate the extent to which they were exposed to the main tailored message and the extent to which they experienced potential distracting elements. Slightly more respondents reported being only partly exposed after listening ($F(1, 214) = 2.94$, $p < .10$) and fewer respondents identified potential distracting elements after listening to the main tailored message compared to those who read the information ($\chi^2(1) = 2.73$, $p < .10$).

Second, differences between conditions were found on perceived usefulness and the general evaluation of the main tailored message ($F(1, 214) = 12.27$, $p = .001$, $\eta_p^2 = .05$ and $F(1, 214) = 12.10$, $p = .001$, $\eta_p^2 = .05$, respectively): Respondents who read the baseline information experienced it as significantly more useful ($M = 4.21$, $SE = .08$) and positive ($M = 5.77$, $SE = .09$) compared to the respondents who listened to the baseline information ($M = 3.81$, $SE = .08$, $M = 5.33$, $SE = .09$). No significant differences were found on the perceived novelty of the information ($p = .29$).

With regard to the evaluation of the smartphone application and intervention content at six-month follow-up, respondents who were exposed to the audio-based content reported to have looked more often for additional information about health and fruit and vegetables (mostly via Internet websites; $F(2, 141) = 3.00$, $p = .053$, $\eta_p^2 = .04$), compared to respondents in the control condition (contrast $p < .05$). In addition, after the audio-based intervention respondents talked more about the topic with other people ($F(2, 141) = 2.49$, $p < .10$, $\eta_p^2 = .03$), compared to the control condition (contrast $p < .05$). When comparing both interventions, the feedback and the smartphone application were experienced equally in terms of personal applicability, novelty, credibility, intensity, usefulness, comprehensibility and visual attractiveness.

Discussion

The current study addressed the efficacy of two tailored smartphone interventions in a sample of people that were invited to participate especially when they perceived the own fruit and vegetable intake as insufficient. The efficacy of the interventions was compared to a control condition in which no tailored health information was provided, and a comparison was made between the text-based and audio-based tailored intervention. Besides testing this main effect, two relevant moderators, referring to perceived own health status and health literacy, were included in this research.

It seemed that the results for fruit consumption and vegetable consumption are different. The results on fruit consumption were supported by the similar findings of the intention to treat analysis, and although the effects were less strong in the selection of respondents, the pattern of findings was still present in respondents with an objectively assessed fruit consumption that was insufficient. The significant main effect showed that

the audio-based intervention was more effective than both the text-based intervention and the control condition. The auditory mode of communication, but not the textual mode of communication, can lead to an increased fruit consumption with an average increase of three pieces of fruit a week. We did not expect specific differences between the efficacy of textual and auditory health information, but it is in line with previous studies on the potential efficacy of auditory information (e.g., Connell et al., 2001). The auditory information may have led to more attention (Alley et al., 2014; Lee, 2011) or it may have been perceived as more rich and personal to the recipient (Chaiken & Eagly, 1983), which is possibly translated into behavior change.

With regard to vegetable consumption, there was no significant main effect of condition. Instead, an interaction between condition and health literacy was found, which was supported by the intention-to-treat analysis, but the pattern of findings was not found in the selection of respondents with an objectively assessed vegetable consumption that was insufficient. Yet, there was no difference between the auditory and textual health information: Both the text-based and audio-based intervention led to a (marginal) significantly higher vegetable consumption in respondents with high health literacy, whereas this was not the case for respondents with relatively low health literacy (within the highly educated sample). For them, both interventions led to a significant decrease in self-reported vegetable consumption at six-month follow-up compared to the control condition. It seems that the current smartphone application was not helpful for people with relatively low health-literacy, at least not in improving a complex behavior such as vegetable intake.

We found that especially respondents who perceived their own health as relatively poor reported higher fruit consumption after being exposed to the auditory health information. It was initially expected that the health information in general would be more relevant for recipients with a poor perceived own health, as they might perceive the necessity to change and are willing to make more investments (Braverman, 2008; Pietersma & Dijkstra, 2011). In other words, there is a match between the persuasive health information and a characteristic of the recipient (Kruglanski & Thompson, 1999). Thus, it seems that recipients with a poor perceived own health did benefit most from the rich and personal auditory information. While speculating, this might be related to an optimal level of threat of the auditory information that was necessary to engage in behavior change, or the promise that the threat will be lowered once the recipient engages in the behavior. It is important to address these underlying processes in further research, as the findings on the current process evaluation measures are unlikely to explain this pattern.

The moderator effect on vegetable intake shows that the intervention in general seemed to have worked especially in respondents with high health literacy. It can be that recipients with relatively low health literacy did not understand all content information or

were not motivated to process the information (Norman & Skinner, 2006; Santo et al., 2005) and therefore discarded the information in general. For recipients with high health literacy it did not seem to matter how the information was communicated, as they may have been open to the content information, regardless of the mode of communication. It is important to unravel the different aspects of health literacy; for instance, education could have played a relevant role, as recipients with a lower education also reported lower health literacy in the current study, but it is also possible that low health literacy is related to a defensive reaction to threatening health information.

Thus, we observed a main effect on fruit intake, and within a subsample of respondents we could also find effects on vegetable intake. This finding on vegetable intake could however not be replicated within a subsample of recipients who indicated consuming insufficient vegetables. This suggests that the findings on vegetable intake are less robust than on fruit intake. In addition, according to a conventional rule of thumb (Cohen, 1992), overall, small to medium effect sizes are found for fruit intake, ranging between $\eta_p^2 = 0.04$ and $\eta_p^2 = 0.08$. It remains the question whether the absence of a main effect on vegetable intake was a matter of power, as the recommended amount of respondents per condition ($n = 64$) was not reached. Yet, the moderating effect of health literacy on vegetable intake showing contradicting results for recipients with relatively low and high health literacy may indicate that it is unlikely to find a main effect on vegetable intake.

The results suggest that not everybody did benefit equally from the intervention, and that lower scores on vegetable consumption can be observed. The tailored health information may thus have negative effects in subgroups of respondents, either when the information is communicated via a textual or auditory channel. This increased our awareness on possible side effects of persuasive health communication. For future research it seems worthwhile to investigate how individual characteristics can be assessed to optimize the practice of persuasive health communication and to increase knowledge on how "hard-to-reach" groups can benefit from it as well (Santo et al., 2005). Possibilities may not only lie in providing persuasive tailored health information via another communication modality (i.e., video-tailoring), but also in the use of other interactive methods and elements (i.e., the use of sensors, serious games, or avatars).

On forehand, we did not expect specific differences for fruit and vegetable intake. It may be that these differences are found because fruit and vegetables are products with different qualities with regard to taste, preparation and culinary uses (Trudeau, Kristal, Li, & Patterson, 1998), and perceived ease of increasing the consumption (Pietersma & Dijkstra, 2011). It may be that after a follow-up period of six months, the auditory intervention was only able to change fruit intake, as this is a relatively less difficult behavior to change. In addition, interventions may differentially lead to increased fruit and vegetable consumption (Chapman & Armitage, 2012). For instance, the context in

which the products are consumed might play a role: Vegetables are more likely to be consumed in a social context (at dinner, with the rest of the family), whereas fruit is more likely to be consumed individually. Therefore, environmental interventions may be more effective for increasing vegetable intake. It seems a rational choice to assess fruit and vegetable consumption separately in future studies.

The effects on the process measures showed that there were no differences between the text-based and audio-based interventions with regard to exposure. However, more follow-up moments were completed by recipients who read the information, compared to recipients who listened to the information. In addition, after the first contact, the baseline textual information was evaluated as more useful and positive compared to the auditory information. After six months however, the textual and auditory interventions were not evaluated significantly different on relevant measures, such as novelty, credibility, comprehensibility, and usefulness. Yet, recipients who were exposed to the auditory information searched more for health-related information and they discussed the topic more often with other people, compared to the control condition. Further research is needed to explain these findings and to investigate how characteristics of the textual and auditory information may possibly have contributed to these differences.

This research also has several limitations. First, a high percentage of respondents did not complete the whole study, which might have biased the current findings. High attrition rates are common in Internet-based health behavior change interventions (Brouwer et al., 2011; Crutzen, Viechtbauer, Spigt, & Kotz, 2015; Mason, Gilbert, & Sutton, 2012). Although initially one could reason that an app might lead to lower attrition rates because people can participate in the study anywhere and at any time, it seems that in smartphone applications it is still a challenge to keep respondents involved after their first visit. This might illustrate the quick and shallow relationship people have with the Internet and smartphone applications in general. Yet, it is found that respondents who dropped out from the research did not differ at relevant pre-test measures compared to the respondents who completed the study.

Although it was not a significant result in this study, more respondents dropped out in one of the intervention conditions, which is a common finding as well in health intervention research (Crutzen et al., 2015). Respondents in the intervention conditions were sent email reminders frequently and they were informed about the possibility to end their participation via email, whereas this was not the case for respondents in the control condition. These aspects of our research might additionally have contributed to differences in attrition between the conditions. A specific improvement may refer to sending reminders as smartphone notifications, instead of e-mail messages.

Secondly, we aimed to increase exposure by sending email prompts and providing regular updates of intervention content (Brouwer et al., 2011). However, it is difficult to detect the actual exposure to the intervention content. People may report that

they were fully exposed to the information, but still we do not know the quality of the exposure. In addition, we could not test intervention components separately, which means we do not know specifically why respondents showed certain improvements. Thus, we were not able to determine the unique contribution of each component of the current smartphone intervention and to make statements about the elements that affected fruit and vegetable intake specifically.

Thirdly, the sample was a selective community sample, which could have biased the results. Respondents were not necessarily a representation of the whole community, as they were mostly highly educated with a Dutch nationality and had to use an Android device to be included in the research. Furthermore, in our recruitment people were invited who did not eat sufficient fruit and vegetables which is obviously a selection of respondents who might be interested in the topic of health and changing their health behavior. In addition, people tend to generally overestimate their fruit and vegetable intake as assessed with self-report measures, as used in the current study (Lechner, Brug, & de Vries, 1997).

In our view, this application may be an effective channel to change fruit and vegetable intake, at least in certain groups of respondents. The development of the audio-based content was more costly and time-consuming compared to the text-based content, but it has shown to have beneficial effects on fruit consumption, or at least for subgroups. The results showed us that it is important to be aware of the possible side-effects of psychological health interventions and to take into account individual differences when exposing respondents to threatening health information and personal feedback on fruit and vegetable intake.

A next step may be to optimize the smartphone application. It is worthwhile to investigate possibilities to expose the subgroups to either one of the current interventions that was shown to be efficient, depending on the specific behavior one would like to change. Furthermore, tracking and sensor technologies can be added to use the smartphone application as an intervention channel to its fullest potential (Kratzke & Cox, 2012; Lathia et al., 2013), which means that recipients can keep track of their daily fruit and vegetable intake and may receive reminders to buy fruit and vegetables when they are in the supermarket. In addition, it would be worthwhile to ensure a higher level of interactivity between the recipient and the smartphone application as an interactive information system.

To the best of our knowledge, this is a first test of the efficacy of communication modalities in an evidence-based tailored smartphone application to stimulate fruit and vegetable intake. It provided us with new insights on the efficacy and processes involved, and we hope to inspire the testing and development of evidence-based smartphone applications in the field of health education and promotion.

Chapter 9

General Discussion

General Discussion

Different key aspects of the communication of a persuasive health message via the auditory mode of communication are studied in the current research. More specifically, we tested the parameters of auditory health persuasion: the conditions under which auditory persuasive information can lead to health behavior change. Two types of parameters are distinguished: Method parameters (i.e., the use of intonation, background music, source introductions, and self-referencing) and individual difference parameters (i.e., involvement and self-efficacy expectations). In the context of the current thesis, the parameters can be used to translate the intervention method into practical strategies (Bartholomew, Parcel, & Kok, 1998, Bartholomew, Parcel, Kok, Gottlieb, & Fernández, 2011; Buunk & van Vugt, 2008; Kok, Schaalma, Ruiter, van Empelen, & Brug, 2004; Kok, Harterink, Vriens, de Zwart, & Hospers, 2006). In addition, two studies compared the auditory mode with the visual mode of communication. In this final chapter, I will summarize and integrate the findings and focus on recommendations for future research and practice in auditory health persuasion.

Summary and integration of the main findings

Recipients seemed to be able to form an impression of the reliability of the source based on the voice only (Chapter 2). More specifically, this impression was probably based on perceptions of the voice (especially the extent to which it is perceived as pleasant) and the person (such as perceived similarity). In addition, the contextual factors (message framing, self-affirmation and gender matching) contributed to perceived source reliability as well. Furthermore, only message framing influenced persuasion, and this relation was mediated by perceived source reliability: Perceived source reliability may be relevant in auditory health communication, but it is not always related to persuasion.

In Chapter 3, it was aimed to gain more knowledge on the effects of voice intonation as a method parameter in auditory health persuasion. Involvement (operationalized as the perceived own health status) was identified as an individual difference parameter. Two studies consistently showed that intonation influenced the intention to increase fruit and vegetable intake: A lower intention was found after listening to the message spoken with a high level of intonation, but only in people with a good perceived health status. In addition, by showing that the intention was higher after applying a self-affirmation procedure, it can be concluded that for these recipients the low intention is related to a defensive response after a self-threat (Harris & Napper, 2005; Sherman & Cohen, 2006). Possibly, this is because the information is less relevant for them; recipients with good perceived health have less to gain from the information. The

motivation to change is likely to be lower, which is associated with a lower priority to invest in changing (Bandura, 1986, 1998). The findings indicate that the use of a high level of intonation is not always beneficial. In fact, it might be associated with unwanted side-effects, at least under certain conditions (e.g., Gélinas-Chebat, Chebat, & Vaninsky, 1996). In the process of the development of the current intervention, it will be most useful to apply health messages that are spoken with a moderate level of intonation.

The use of background music was tested as another method parameter in Chapter 4. Again, involvement (operationalized as health value) was identified as an individual difference parameter. In recipients who moderately valued their health, lower scores on intention were found after listening to the music recipients positively or negatively identified with, whereas the highest intention was reported after listening to the health message without background music. It may be that recipients who moderately value their health are not ready to invest in health behavior change and show defensive responses instead (Dijkstra & van Asten, 2014). A process of "motivated distraction" seems to better explain the results than identification processes. With regard to the development of our smartphone application intervention, it seems better to use a health message without background music.

In Chapter 5, the auditory mode of communication was compared to the visual mode of communication. Recipients either were exposed to an auditory or textual health message, or to a text stream, which means that the content information was offered in meaningful units of a few words that subsequently appeared at a fixed point on a screen for two seconds. The immediate intention and later behavior were only related to each other in the text stream condition, which has probably less opportunities to engage in defensive self-regulation (Chambliss & Garner, 1996; Pfau, Holbert, Zubric, Pasha, & Lin, 2000; van 't Riet & Ruiter, 2013): Only in the text stream condition, the low post-test intention was translated into low fruit and vegetable consumption. The findings show that the relationship between intention and behavior can partly depend on the "external" availability of sources for self-regulation. Although central pieces of information were better remembered (recognized) after listening to the auditory message, no differences between the auditory and textual message were reported on behavior. To further explore the effects of these communication modes, the auditory and textual message were compared to each other again in the smartphone application.

Chapter 6 provided insight into the use of source introductions in the auditory health intervention. Involvement (operationalized as health value) was again a relevant individual difference parameter. Especially when the source introduced herself as a physician - probably making the persuasive message the most threatening - differences between those scoring moderate versus high were observed. Only recipients who valued their health as top-priority seemed to benefit from listening to this tough source: The message is in line with their most important value. Again, recipients who valued health

moderately seemed not willing to invest in change, as evidenced by their lower scores on persuasion when the message was communicated by the physician. However, they were able to face the message of their in-group member, the student. Still, none of the source introductions led to significantly higher scores on intention or behavior compared to the control condition without a source introduction. Thus, in the absence of such a main effect, it will be most useful to apply health messages without source introduction in the intervention.

In Chapter 7, the effect of self-referencing is investigated as a method parameter by assessing the influence of tailoring ingredients in auditory persuasion. With regard to intention, providing feedback on the personal fruit and vegetable intake resulted in the highest intention. In addition, involvement (operationalized as the own perceived health status) was identified as a relevant individual difference parameter: Recipients who perceived the own health as good showed no differences between the conditions, whereas recipients who perceived the own health as poor lowered the intention especially after the personalized auditory information. With regard to behavior, however, perceived self-efficacy was identified as an individual difference parameter, showing that the overall fruit and vegetable intake was lower for recipients with low perceived self-efficacy. Yet, after listening to the personalization message, a high fruit and vegetable intake was found in these recipients. It may be that auditory personalization was so strong that it motivated recipients with low self-efficacy expectations to make more investments. Thus, auditory tailoring seems to be effective in some circumstances. The differential effects on intention and behavior further illustrate that the relationship between intention and behavior is complex (Sheeran, 2002; Webb & Sheeran, 2006; Sutton, 1998), also in auditory communication as demonstrated in Chapter 5.

In sum, the findings on the parameters learned us to avoid the use of a high level of intonation, background music and source introductions, as no main effects could be reported for these specific method parameters in the current studies. Yet, with regard to self-referencing as a parameter, feedback and adaptation could be used in the smartphone intervention. That is, feedback is one of the most relevant behavior change techniques in general (Abraham & Michie, 2008; Brug, Glanz, van Assema, Kok, & van Breukelen, 1998; Dijkstra, 2005, 2008) and the main effect on intention seems promising: It led to higher persuasion after a single moment of exposure, whereas recipients will be more often exposed to the feedback in the intervention. In addition, the results were inconclusive with regard to the effects of adaptation but the rationale of adaptation (Dijkstra, 2008) and the empirical evidence in textual persuasion (for example, Skinner, Strecher, & Hospers, 1994; Snyder & DeBono, 1985) is strong enough to include it in the smartphone intervention. Personalization will not be applied in the current smartphone intervention for two reasons; it will be difficult in terms of logistics to deliver these auditory personalized messages, and when taking into account the significant main effect, the

lowest score on intention was found after respondents listened to the personalized message, suggesting that personalization can be counter-effective.

Finally, the smartphone intervention was developed to compare the efficacy of textual and auditory tailored health information on fruit and vegetable intake while taking into account the findings of the earlier studies. The intervention was tested in a randomized controlled trial with a follow-up period of six months (Chapter 8). Higher fruit intake was reported after exposure to the auditory intervention, showing that auditory information as integrated in a smartphone application can change health behavior in the advocated direction. Two individual difference parameters were identified: involvement (operationalized as perceived own health status) and health literacy. The effect on fruit intake was especially found in recipients who perceived the own health as poor; for them, the auditory mode of communication did have beneficial effects up to six months later on fruit intake, possibly because they were willing to invest in their health. In addition, recipients with high health literacy reported a higher vegetable intake after being exposed to either one of the interventions, whereas recipients with relatively low health literacy reported a higher vegetable intake when not exposed to one of the interventions at all. They may not have understood the health information or have lacked the motivation to change the health behavior. All in all, we learned that the smartphone application intervention has the potential to change behavior six months later. Different conditions were identified under which the intervention was effective.

The individual difference parameters

The current research showed that the method parameters influenced persuasion in interaction with individual difference parameters. Involvement and self-efficacy expectations were identified as relevant individual difference parameters, whereas health literacy seemed to have an additional influence in the smartphone application. These moderators can be regarded as indicators of how recipients may react to threatening health information. The findings will be integrated and discussed below.

Indicators of involvement. Health information is more personally relevant to two groups of recipients with a high level of involvement: those who perceive the own health as relatively poor and those who value health as a top-priority in their lives. Both groups will be more eager to process the information and more willing to make investments to perform the behavior. Recipients with a poor perceived own health have more to gain from the information, as they can use the information to improve their own health, while recipients with a high health value prioritize health and the information is in line with their most important value. Therefore, it was initially expected that highly involved recipients are likely to change their health behavior in the advocated direction, regardless of the applied method parameters.

This is confirmed by several findings in the current thesis, for instance when in

highly involved recipients no differences between the conditions were found: Recipients for whom the information was highly relevant reported an increased intention compared to recipients for whom the information was less relevant, for instance regardless of the level of intonation and self-affirmation (Chapter 3). In addition, the highly involved reported an increased intention or fruit and vegetable intake after being exposed to the health information that may have induced the strongest threat; they did not seem to get defensive easily. This was the case when the information was accompanied with negative identification music (Chapter 4), when the source was introduced as a physician (Chapter 6) and when they were exposed to the rich and immediate auditory information in the smartphone application (Chapter 8). These findings indicate that highly involved recipients are willing to invest more effort to change the behavior. An exception refers to the low intention that was found after listening to the personalization message (Chapter 7). The perceived level of threat may have been too high in this specific condition, which may have contributed to a defensive response, and therefore, a low intention. Such a reaction to personalization has also been found in highly involved smokers towards a textual message on the negative consequences of smoking (Dijkstra, 2014), and it is in line with personalization being a strong tailoring element that needs to be applied in a careful way (Dijkstra & Ballast, 2012).

In contrast, the information is less relevant (or not relevant enough) for recipients with a low level of involvement. For those who perceive the own health already as relatively good the information indicates less benefits of fruit and vegetable intake, while for those who value health moderately the information is not in line with the most important value; they have others values to work on. Both groups have less to gain from the information and lack a certain motivation or readiness to change (e.g., Braverman, 2008). They have a lower priority to make investments to change their health behavior. Therefore, defensive processing of the information can be expected in recipients who are not highly involved (Dijkstra & van Asten, 2014; Pietersma & Dijkstra, 2011). This was confirmed by the defensive response after listening to a message with a high level of intonation (Chapter 3), and the pattern of findings of Chapters 4 and 6. However, this was not found when testing the effects of self-referencing (Chapter 7) and the smartphone application (Chapter 8): The low involved recipients did not show differential responses between conditions that translated into persuasion. It may be that levels of threat were insufficient to motivate behavior change.

Based on dual-pathway models of persuasion (e.g., elaboration likelihood model; Petty & Briñol, 2012; Petty & Cacioppo, 1986, heuristic systematic model; Chaiken, Liberman, & Eagly, 1989), the characteristics of the voice and speech can be conceptualized as peripheral cues that activate heuristics. In the most extreme case, based on these models it could be expected that high involved recipients would be persuaded especially by the content information, and therefore would show no

differences between the conditions. They use the central route of information processing and show no defenses towards persuasive health information using strong arguments. Furthermore, low involved recipients would be persuaded by the contextual information and show differences between conditions (the method parameters): They might use the peripheral route of information processing. It also could be reasoned that low involved recipients would show more behavior change after listening to auditory information, compared to reading textual information. That is, auditory information consists of more rich information in terms of peripheral cues (e.g., voice characteristics; Braverman, 2008; Chebat, El Hedhli, Gélinas-Chebat, & Boivin, 2007), whereas high involved recipients may want to elaborate on the content information by re-examining the information, which is less possible while listening to auditory information (Chambliss & Garner, 1996). However, this pattern for low and high involved recipients was not found when we compared the efficacy of the communication modalities in Chapters 5 and 8 of the current thesis.

In most studies, our measurement of involvement did not lead to the expected differences between low and high involved recipients in the perspective of dual-pathway models of persuasion. It may be that there were no clear and consistent effects for low and high involved recipients because of the nature of auditory information processing. Within dual-pathway models of persuasion, the voice and speech characteristics are characterized as the peripheral cues of the information, to be processed via the peripheral route of information processing, whereas the content information is processed via the central or systematic route. However, in auditory communication, the content information and the voice and speech characteristics are processed simultaneously, from the beginning to the end. The source is now represented by the voice of the messenger, which cannot be distinguished from the content information. Thus, the content information and the peripheral cues are integrated in mental images (D'Esposito et al., 1997): The words as well as the voice and speech contribute to the quality of the mental image. For instance, the findings reported in Chapter 3 suggest that a threatening message spoken with a high level of intonation (peripheral information) may make the consequences of a certain health behavior (central information) seem more severe. Indeed, research shows that peripheral information can bias central processing, leading to more or less persuasion (see Levin, Nichols, & Johnson, 2000).

Besides the dual-pathway models of persuasion, another perspective is offered by the unimodal of persuasion (Kruglanski & Thompson, 1999), which does not make an explicit distinction between two routes of information processing. Rather, it is reasoned that recipients are persuaded by cues of the message that match with personal premises of the recipient, without the distinction between central and peripheral cues. Instead of the voice or source as a peripheral cue, it is now treated as information that may match with a personal premise that can lead to persuasion, for example, "when a doctor talks

about fruit and vegetables, low intake must be related to serious conditions". This is an interesting issue to take into account in the current research (see for instance Chapter 6). All in all, dual-pathway models seem not a very strong explanation of the effects of involvement that were found in our studies.

In the present context, it is also important to distinguish between subjective and objective involvement. In studies testing the dual-pathway models of persuasion, involvement is most often operationalized as objective involvement: Low involvement means that the topic of persuasion is objectively irrelevant or does not apply to the personal situation of the recipient. For instance, a student recipient is thought to be highly involved in the case of an increase in tuition fees at the own university, or low involved in the case of an increase in tuition fees at a university at the other side of the country. However, in the domain of health this is different. That is, health is objectively relevant for everybody, and, therefore, health information is objectively relevant for everybody. Furthermore, although a recipient may consume sufficient fruit and vegetables according to guidelines, this does not mean that the recipient finds the topic irrelevant. Similarly, a recipient may consume insufficient fruit and vegetables according to guidelines, but this does not mean that the recipient finds the topic not personally relevant. Therefore, the involvement measures that were used here are measures of value-involvement, defined as the association between the topic of the persuasive information (health) and the recipient's value (Eagly, 2007; Johnson & Eagly, 1989; Pietersma & Dijkstra, 2011): Perceived own health and health value. With regard to the latter measurement, another aspect of involvement in the domain of health stood out: Almost all people do value health as they know that it is objectively relevant for them. Therefore, we distinguished between moderate (but not low) and high health value (Dijkstra, 2014; Dijkstra & van Asten, 2014; Pietersma & Dijkstra, 2011). The robustness of the effects of involvement in the present studies is further indicated by the fact that statistical analyses were controlled for objective and subjective measurements of fruit and vegetable intake (when possible).

Self-efficacy expectations. Perceived self-efficacy is identified as a moderator in testing the effect of self-referencing as a method parameter by means of tailoring ingredients (Chapter 7). It refers to perceived behavioral control, or the perceived capabilities to engage in the advocated health behavior (Bandura, 1986; Conner, Norman, & Bell, 2002; Kreausukon, Gellert, Lippke, & Schwarzer, 2012) and it was here operationalized as the extent to which the behavior is perceived as difficult to perform (de Vries, Dijkstra, & Kuhlman, 1988; Webb & Sheeran, 2006).

Recipients with low self-efficacy expectations can experience difficulties in performing and maintaining the behavior and may not see the possibility to change the health behavior in the advocated direction. Therefore, people with low perceived self-efficacy will not easily change their behavior and they may even be more inclined to react

defensively when confronted with threatening information. In Chapter 7, indeed, lower scores on fruit and vegetable intake were found for this group. Yet, recipients with low perceived self-efficacy reported an especially high fruit and vegetable intake after listening to the personalized message; a message that can be expected to result in a high threat. Their reaction was not in line with our initial expectations, but it may be that the auditory personalization was so strong for this group that central processing was instigated that penetrated the defenses recipients originally had (Block & Williams, 2002; Dijkstra, 2014). The resulting threat must have led to the willingness to make more investments to change.

Recipients with high self-efficacy expectations do experience less difficulties in performing the behavior and perceive they can act according to the persuasive health information. The results showed that recipients with high perceived self-efficacy did not show defensive responses after being exposed to the threatening information. They were persuaded evenly high regardless of the application of tailoring ingredients. In addition, this finding confirms the theoretical assumption that a threat can lead to behavior change, but only when people have a sufficient level of self-efficacy expectations (Maloney, Lapinski, & Witte, 2011; Witte, 1992, 1994).

Health literacy. When testing the effects of the smartphone application in a community sample, health literacy was found to moderate the effects on vegetable intake (Chapter 8). It was assessed by the perceived ease or difficulty to understand health information in general (for instance, from a physician). Recipients with lower health literacy reported a lower vegetable intake after being exposed to the health information, either the auditory or the textual, whereas recipients with high health literacy reported a higher vegetable intake after being exposed to the auditory or textual health information. It is not immediately clear why people with relatively low health literacy (given the highly educated sample) consumed significantly less vegetables after being exposed to the app. This finding suggests that the app was not inert for these people, meaning that other factors than the (in)ability to understand the information could have played a role. Although health literacy was not significantly related to our measurements of involvement (or self-efficacy), recipients with low health literacy may have a lower motivation to change the health behavior in the advocated direction. Thus, health literacy may not only refer to a cognitive ability but also to a general reluctance to process health information. Besides a motivational construct (Nutbeam, 2000, 2008), health literacy may also be related to suboptimal health beliefs, more negative attitudes towards health behaviors and less perceived possibilities to self-regulate the persuasive health information (Federman, Wisnivesky, Wolf, Leventhal, & Halm, 2010). Based on the results we cannot draw any firm conclusions with regard to the underlying processes in people with low health literacy. It is however important to unravel the construct of health literacy (also in oral forms of health communication; Rubin, 2012) and increase knowledge on how

people with low health literacy can be stimulated to increase fruit and vegetable intake, especially as low health literacy is associated with poor health outcomes (Mõttus et al., 2014; Norman & Skinner, 2006).

The complex role of threat

Based on the findings in the current thesis, it seems that specific individual differences may influence persuasion under specific conditions. However, we do not know on forehand what individual difference will influence persuasion in a specific situation. That is, the influence of individual differences depends on the level of physical and self-threat as perceived by the recipient. This threat is an essential and complex mechanism in the current research; it is the motive to engage in health behavior change in the first place (Tesser, Crepaz, Collins, Correl, & Beach, 2000; van 't Riet & Ruiter, 2013). The threat appraisal is influenced by the method parameters (how is the information presented in terms of intonation, background music, source presentations and tailoring mechanisms) and the individual difference parameters (level of involvement and perceived self-efficacy). Yet, the relative differences in threat between the different conditions remain unknown in the current research. That is, there is no standard against which differences in threat potential of manipulations can be judged. For example, it is unknown whether an auditory health message communicated by the physician as a source is 10% more threatening or 50% more threatening than the no-source message. In a psychological model in which it is expected that these manipulation will lead to different levels of threat, the assessed level of threat may even depend on the sample composition (e.g., the amount of recipients with a high health value). Thus, the extent to which messages are threatening is largely an empirical issue; on forehand, it is unknown how the threat is perceived in a specific population and when the threat becomes too high and may lead to defensive responses (van 't Riet & Ruiter, 2013). The basic lack of insight into absolute levels of threat and the influence of the sample on the level of threat shows the complexity of the research and practice of (auditory) persuasion.

In the following paragraphs, I will reflect on some remaining relevant issues that are typical for the present research. These issues concern the nature of the auditory communication, the context of persuasion and our measures of fruit and vegetable intake and intention.

Auditory communication

In auditory communication, the voice is the most important means to communicate the content information, which consists of voice and speech characteristics that may consequently influence source evaluations and persuasion (e.g., Chattopadhyay, Dahl, Ritchie, & Shahin, 1999; Chebat et al., 2007). It is reasoned that auditory health information is perceived as more threatening as it includes richer information and it is

more immediate. Because of the latter, the auditory information may seem to be more personally addressing the recipient (Chaiken & Eagly, 1983; Jensen, Farnham, Drucker, & Kollock, 2000), which means that auditory presented information is self-referencing to a certain extent. In addition, when auditory information is presented through headphones it may even create a more intense listening experience compared to listening through speakers (Kallinen & Ravaja, 2007). These aspects make it plausible that auditory persuasion has unique effects, and that theories and findings regarding textual persuasion may not apply to auditory persuasion. However, most studies of the current thesis were not developed to contrast the auditory mode with other communication modes, but to learn on the effects of auditory health persuasion under different conditions to develop an auditory app to be used in the practice of large scale health promotion.

Throughout the current studies, we only used a small selection of unique voices, which limits the generalizability of the findings. In all chapters, a female voice was used; only in Chapter 2 a male and female voice were used, but no clear gender effects could be reported. Although people mostly can accurately assess whether the speaker is male or female (Wolfinger & Rabow, 1997), in these studies gender was not a relevant aspect of perceived similarity between the speaker and the recipient, and the gender matching variable presented in Chapter 2 did not influence persuasion either (although a gender match did lead to higher perceived reliability). Yet, one might expect differences between listening to a male and female voice. For instance, characteristics of (wo)men might activate certain stereotypes that can transfer to the content of the message and therefore can influence persuasion (i.e., a female voice might be associated with caring, security and warmth; Ko, Judd, & Blair, 2006). In addition, it has been found that the communication of health information by a female voice (but not a male voice) was associated with the identification of more risks for both male and female listeners, particularly when the content was female-stereotyped (Dearborn et al., 2006).

Besides the gender of the messenger in auditory persuasion, the gender of the recipient might also make a difference: Male and female recipients might respond differently towards persuasive health information. For instance, men may have different goals and expectations, and they may perceive the information in another context compared to women: Men tend to react more defensively towards persuasive health information, possibly because they are more likely to take risks and deny potential vulnerability (Courtenay, 2000; Emslie & Hunt, 2008). Possibly, the influence of our method parameters may work out differently for men and women. However, in the current studies, we did not take this matter into account. To deal with the specificity of the voice, “prototypical” voices were selected that did not contain any possible distracting elements. The benefit is that the differences between our studies cannot be attributed to large differences in voices. Further research is needed to study the influence of common idiosyncratic elements of human speech on persuasion.

Perspectives on persuasion

Throughout the empirical chapters of the current thesis, recipients were exposed to persuasive health information on the topic of fruit and vegetable intake. Besides increasing our knowledge on the processes involved, we primarily aimed to change health behavior in the advocated direction. Thus, in the development of the persuasive health messages, arguments were selected to convince recipients on the positive effects of fruit and vegetable intake. This is common practice in, for example, health persuasion with regard to alcohol consumption or smoking in which only the benefits of reducing alcohol consumption and quitting smoking are addressed. In the context of fruit and vegetable intake, these positive arguments can refer to the prevention of chronic diseases (Boeing et al., 2012; WHO, 2003) and being part of a nutritional pattern aimed to reduce weight or stay healthy (van Kreijl, Knaap, & van Raaij, 2006).

Although the potential health benefits of fruit and vegetable intake are well-known and generally outweigh the potential negative outcomes by far, negative outcomes of fruit and vegetable intake do exist as well. For example, more balanced persuasive information might include information about the magnitude of the positive effects and about potential risk factors of disproportionate consumption of fruit (juices) and vegetables. That is, robust, but only small protective effects of fruit and vegetable consumption have been found on specific types of cancer (WCRF/AICR, 2007) and a disproportionate consumption of fruit (juices) can be a potential risk factor for dental health problems (Jarvinen, Rytomaa, & Heinonen, 1991; Moynihan & Petersen, 2004), and diabetes type II (Bazzano, Li, Joshipura, & Hu, 2008). Furthermore, it is important to recognize that recipients may have worries with regard to the exact health benefits of fruit and vegetables, for example because they may contain less nutrients than in the past or they may have been treated with pesticides (Petrie et al., 2001).

When the persuasive information aims to support people to make a balanced decision themselves, for instance in a health education context, it may be appropriate to acknowledge that both objectively positive and negative arguments exist. In addition, a one-sided approach of persuasion (as is used in the current studies, and which is similar to the health communication by national health institutions) is aimed to persuade recipients to increase their fruit and vegetable intake. Therefore, scientists need to provide information about the effectiveness of interventions and about the (positive and negative) effects of fruit and vegetable intake, while it is up to policy-makers to select the types of interventions for public health purposes.

Fruit and vegetable intake

The research presented in the current thesis focused solely on fruit and vegetable intake, referring to a common health behavior that comprises an important aspect in general dietary patterns. Nowadays, it is also a behavior that is or should be performed

'to prevent the onset of a health problem' (Rothman & Salovey, 1997, p. 9), and it needs a certain investment to create the actual health benefits. This means that our findings cannot be automatically generalized to other health behaviors that are illness-detecting (i.e., screening behaviors), or unhealthy behaviors that have strong (hedonic) functions (e.g., smoking or high-caloric food intake).

Furthermore, we used a continuum to measure fruit and vegetable intake, which means we did not assess it in the perspective of a guideline. Guidelines for fruit and vegetable consumption differ across the world and are subject to change; for instance, most current recommendations take into account that fruit and vegetable juice and apple sauce (a common Dutch product) are sweetened. We included these products in our measurement of behavior for the sake of consistency. Only in Chapter 8 the category of fruit and vegetable juice was excluded, as this category did not allow us to distinguish between fruit and vegetable intake.

We regarded (the intention to increase) fruit and vegetable intake as an aggregated measure as is often done in current dietary guidelines and research. However, no particularly high correlations between the perceived intake of fruit and the perceived intake of vegetables were found (for instance, ranging between .23 to .45 across the studies in Chapter 4-7), and in Chapter 8, different effects on fruit intake and vegetable intake were reported. It can be reasoned that fruit and vegetable intake are markedly different behaviors, for example with regard to taste, preparation and culinary uses (Trudeau, Kristal, Li, & Patterson, 1998). That is, fruit is mostly consumed at breakfast or as a snack throughout the day and it does not need a lot of preparation. In general, it takes more time and different tasks and capabilities to prepare vegetables, that are mostly consumed as a part of dinner. In addition, the perceived ease of changing the intake of fruit or vegetables may differ (Pietersma & Dijkstra, 2011). This is in line with the finding of the influence of health literacy on vegetable intake (and not on fruit intake, Chapter 8): It may be that people with low health literacy find it especially difficult to increase their vegetable intake as it demands multiple behaviors. Thus, the different qualities of fruit versus vegetable consumption may be associated with different underlying psychological processes to be targeted in health interventions, which can translate into differential effects on fruit intake and vegetable intake (Chapman & Armitage, 2012).

On forehand, we did not hypothesize differential effects of the smartphone intervention on fruit intake and vegetable intake. It is argued that the differences between the effects on these behaviors may be caused by the follow-up period: In our earlier experiments with found effects on fruit and vegetable intake as an aggregated measure, the follow-up period was mostly two weeks, compared to the six-month follow-up period in the smartphone intervention. As proposed in the Health Action Process Approach (Schwarzer, 2008), different structures of motivation can play a role in health behavior

change. It may be that on the short term the obstacles that people face to consume more vegetables (e.g., preparation, cooking techniques) are overcome by a strong motivation; the promise to prevent illness. However, on the longer term the actual experience with vegetable meal preparation may become more important. In addition, in fruit consumption, with its fewer obstacles, this longer term process may be different compared to the processes in vegetable consumption.

The measurement of intention. Intention is often expressed as 'the most immediate and important predictor of a person's behavior' (Sheeran, 2002, p. 1), also in the context of fruit and vegetable intake (Conner, Norman, & Bell, 2002; Pietersma & Dijkstra, 2011). In the current research, the intention regarding fruit and vegetable consumption is operationalized (with at least two and maximally six items) as the extent to which one is planning and/or the likelihood to *start* performing the behavior: Respondents were asked to report their intention to *start* eating *more* fruit and vegetables, at pre-test as well as at post-test. This formulation may seem especially relevant for recipients who consume insufficient fruit and vegetables. That is, people who do already consume enough fruit and vegetables may score low on this intention because they do not intend to eat more than enough. Thus, low scores on our measurement of intention can reflect different interpretations by recipients.

The different interpretations are caused by the participants' perceptions of the own fruit and vegetable intake. These were assessed at pre-test ("Is your fruit intake sufficient?", and "Is your vegetable intake sufficient?"). This perception of one's own intake was positively correlated ($r = .64$, $p < .001$) with the objective (self-reported) fruit and vegetable intake as indicated at pre-test, also within specific conditions (this could only be tested in Chapter 7). In most studies, we controlled for this variable when analyzing the results on intention or behavior, thereby neutralizing possible effects of differences between the conditions in the distribution of this variables. More importantly, we checked the influence of the perception of the own fruit and vegetable intake on the outcomes of conditions by conducting the main analyses in two chapters (4 and 5) only in recipients who subjectively reported eating either insufficient fruit or vegetables. The results in this subsample were very similar to the effects in the sample including the recipients who thought they consumed sufficient fruit and vegetables. This suggests that the formulation of our intention measures ("eating more fruit and vegetables") did not have a strong influence on the results, probably because recipients who think they eat sufficient fruit and vegetables often might still be motivated to increase their intake and may report a high intention regardless of the formulation of the question. However, the intention measures as used in the current research are not optimal and need to be revised to increase its relevance to all recipients.

Furthermore, intention is assessed within different timeframes (one month, six months, and five years), as is suggested by Ajzen (1988) and as has been done in

previous research in which this format was the strongest predictor of subsequent behavior during a period of eight months (Dijkstra & den Dijker, 2005). Within the current research, the effects across the different studies were not always found on all timeframes. That is, the composition of the specific sample will influence which timeframes effects will be found. For instance, in a low motivated sample a low intention to change within one month may be reported, leading to a left-skewed distribution when only this timeframe would be taken into account. On the other hand, in a more motivated population a right-skewed distribution might be found with regard to the one-month time-frame. Therefore, multiple timeframes were included in the intention measure.

The relationship between intention and behavior. In Chapter 5, 6, and 7, both intention and behavior were taken into account as outcome measures. In all three studies, differences on behavior were found, independent of the results on intention. To increase our knowledge on the relationship between intention and behavior, post-hoc correlational analyses were performed while taking into account three relevant covariates: pre-test intention, the own perceived health and the subjective fruit and vegetable intake. No significant correlations between intention and behavior were found within these three samples (r ranging from -.16 to .16).

In two studies, the correlations could be analyzed within the specific conditions (in Chapter 6, the number of recipients per condition was too small, $n \leq 18$): As reported in Chapter 5, the correlation between intention and behavior was only significant when recipients were exposed to the text stream ($n \geq 42$ per condition: $r = .37$, $p < .05$). This was explained by the absence of "external" self-regulatory opportunities when exposed to the text stream: This may have modified or lowered the use of self-regulatory defenses. Furthermore, a marginally significant correlation of similar magnitude between intention and behavior was found in the personalization condition (Chapter 7, $n \geq 24$ per condition: $r = .39$, $p < .10$). The combination of the auditory mode, which is relatively direct and self-referring, and personalization, which explicitly addresses the recipient, may have penetrated emotion-regulation processes (Dijkstra, 2014), thereby also influencing the use of self-regulatory defenses.

These findings can be seen in the perspective of other research showing that the intention-behavior relationship may depend on moderating factors (conditions) that can facilitate or hinder health behavior change (Cooke & Sheeran, 2004; Sheeran, 2002; Schwarzer, 2008). Further research is needed to unravel the processes of self-regulatory defenses and the intention-behavior relationship. For instance, the findings in Chapter 5 cannot be automatically generalized to other situations, as a negatively framed message with a high level of intonation was applied here. Finally, the correlations within the remaining conditions of the two studies as reported above were non-significant (ranging from -.03 to .23). Given the non-significant correlation between intention and behavior

when an auditory message was presented (in Chapter 5), this finding is not unexpected. In general, the inconsistency between intention and behavior has been widely recognized as the intention-behavior gap (Sheeran, 2002; Webb & Sheeran, 2006).

Our measure of intention reflects a reaction to a threat as immediately assessed after being exposed to persuasive health information. This immediate intention informs us on the process of self-regulating threatening health information in auditory persuasion. Possibly, when recipients can perform the behavior immediately after the formulation of a high intention, this may automatically translate into behavior (Bargh & Chartrand, 2000). However, the exact processes of change after the formulation of an initial intention are hard to assess: After the experimental setting in which the intention was formed, the intention may change once the recipient is at the supermarket or at home, and it may be affected by experiences of personal barriers, by memories, by implementation intentions, social norms or self-efficacy expectations. In the smartphone application intervention we aimed to take these factors into account by designing repeated exposure and repeated activation of knowledge and intentions, and tailoring the content information to personal barriers and beliefs (Chapter 8). All in all, our research showed that a formulation of an immediate intention mainly reflects a reaction to threatening health information, and intention and behavior become related under circumstances in which external sources for self-regulation are less available to the recipient. By taking into account the intention to increase fruit and vegetable intake, we learned about the processes involved in auditory health persuasion.

Theoretical and practical implications

The current research increased insight into the processing of auditory information, a wide-spread phenomenon in our daily lives, for instance while listening to the radio and having telephone conversations. We asked ourselves the practical question how we could develop an effective intervention to increase fruit and vegetable intake, with the use of behavior change techniques (Abraham & Michie, 2008), the Intervention Mapping protocol (Bartholomew et al., 1998, 2011; Kok et al., 2004) and the PATH-model (Buunk & van Vugt, 2008). Auditory persuasion is investigated from different points of view by taking into account the influence of method parameters and individual difference parameters, as specified in our model of auditory persuasion. Eventually, this helped us to gain understanding on the conditions under which auditory health information can lead to persuasion and for whom. For instance, providing feedback on the own fruit and vegetable intake increased the intention. Furthermore, negative findings with regard to the parameters of auditory information processing were found as well; for instance, a high level of intonation lead to a lowered intention in low involved recipients, and background music and source introductions did not seem to have beneficial effects in auditory health persuasion. These specific research findings as well as our broader

experience with auditory communication in these studies have been essential in the development of the smartphone application intervention.

Although we focused on the main behavior change techniques available and we took into account some of the most relevant parameters of auditory health information, the current research does not claim to provide a systematic test of the method parameters or the individual difference parameters. The model of auditory persuasion presented in the introduction of this thesis was used to design research on important aspects of auditory persuasion to be tested. The research was not designed to test the model. For example, it is assumed that the appraisal of threat plays an important role in auditory persuasion processes, but at the same time we did not measure any of these influences directly. This means we explored the relationship between aspects of auditory health information (such as voice characteristics) and persuasion (instead of threat). We hope to inspire further research to study the interplay between the perceived threat and the (method and individual difference) parameters under which auditory health information may lead to health behavior change.

The test of our smartphone application can be regarded as the most important practical implication of the (experimental) studies. Effective behavior change techniques were applied, such as persuasion and argumentation, based on psychological determinants of fruit and vegetable intake (Guillaumie, Godin, & Vézina-Im, 2010). In the current thesis, method parameters and individual difference parameters were tested to develop practical strategies to include in the smartphone intervention. Other practical strategies were applied that were not explicitly tested but that were added to create a coherent intervention package. For instance, to increase perceived self-efficacy, recipients received information about skills and relevant practical tips. Finally, the efficacy of the smartphone application intervention was tested, as reported in Chapter 8. The actual implementation of the smartphone intervention to promote fruit consumption within a larger societal health promotion context may be a next step. In the following section, I will briefly address new directions for future research and practical recommendations.

Future studies and recommendations. Listening to information via smartphone applications is widely accepted, which enhances the possibilities to implement it as an intervention in diverse settings, such as the workplace, neighborhood and health care services. Yet, it remains a challenge to develop smartphone applications that people keep using within the personal routine of using apps, as people tend to spend most of the time of online activities in top-ten smartphone applications (TNS NIPO, 2012). Even in our scientific study in which incentives were applied to stimulate people to use the smartphone application, only 44.5% of the research participants finished the post-test questionnaire, and on average participants logged in 7.6 times during the 6 months period. Outside the research context these numbers on the actual use of smartphone health applications can be expected to be substantially lower (Comstock, 2014; Evers,

Cummins, Prochaska, & Prochaska, 2005). Thus, getting people to install the application, visit it, return to it, and follow its recommendations, is presently a main issue with regard to Internet-delivered interventions (Brouwer et al., 2011; Crutzen et al., 2008).

To build effective interventions that are actually used, the collaboration in a multidisciplinary team with technologists, scientists and health professionals is essential. In general, scientists aim to include the elements that are effective for health behavior change, but they lack the knowledge on how technological aspects can be applied. This is where the technologist can complement the capabilities and knowledge of the scientific psychologist (e.g., what is technologically possible with regard to communicating reminders to recipients). Both perspectives need to be integrated to be able to use the ground rules that are necessary to develop an effective smartphone application intervention.

Another step to be made in the development of future smartphone applications to stimulate health behavior change is to ensure an increased level of interactivity. This is in line with the elementary basis of interactive information systems, such as persuasive robots, that may serve as online coaches and that can interact more directly with the recipient, while making use of the same relevant ground rules as our smartphone application. Furthermore, these robots may use auditory input, they may observe natural cues such as gazing (Ham, Cuijpers, & Cabibihan, 2015) and they might adjust their level of intonation while speaking to ensure more fluent conversations with recipients. These are prospective challenges for future research in this area of (health) persuasion and behavior change.

Furthermore, based on the findings in Chapter 8 it seems relevant to explore how the smartphone application can be effective for people with low health literacy, as both the auditory and textual intervention led to a lower vegetable intake. It is important to gain more knowledge on which intervention characteristics possibly could have contributed to this negative effect, in order to discover how these people may benefit from a smartphone intervention as well. Until now, no magic bullet has been found to communicate health information to “hard to reach” groups (Santo, Laizner, & Shohet, 2005). As our experiments were mainly conducted among student recipients with a high educational level, it is recommended to keep doing further research on effective behavior change techniques for vulnerable groups, such as people with low health literacy or a low socio-economic status.

To conclude, the current research helped us to improve our understanding on the processes of auditory forms of health communication. In addition, the smartphone application intervention contributed to an important element of health behavior change, and showed that auditory information can have beneficial effects in specific segments of users. To stimulate people to eat more healthily, it seems promising to include *auditory* forms of health persuasion in integrated policies, not only because it can be effective,

but also because people are used to be exposed to auditory information in our society today. In the future, novel technological applications for health behavior change can be expected, with an increased use of interactive and more fluent auditory communication. Furthermore, scientists in the field of health communication and persuasion are stimulated to focus on effective behavior change techniques in vulnerable groups of people as well. All these efforts, including the efforts invested in the present dissertation, aim to gather knowledge on our world to find possible ways to support behavior change.

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Nederlandse Samenvatting

Dutch Summary

Nederlandse Samenvatting

Het eten van voldoende groente en fruit heeft verschillende gezondheidsvoordelen. Toch eten veel mensen onvoldoende groente en fruit, ook in Nederland. Het is daarom belangrijk om groente- en fruitconsumptie te stimuleren. Enerzijds is het communiceren van visuele gezondheidsinformatie door middel van bijvoorbeeld brochures of posters een veelvuldig gekozen manier om gezondheidsinformatie over te dragen aan een breed publiek. Anderzijds worden we dagelijks blootgesteld aan auditieve informatie via telefoon en radio. Als men aan zijn of haar gezondheid wil werken, is het tegenwoordig ook mogelijk om smartphone applicaties te gebruiken met geïntegreerde auditieve informatie, bijvoorbeeld in de vorm van een virtuele coach tijdens het wekelijkse hardlooprondje. De vooruitgang in technologische mogelijkheden zoals MP3-technologie en het gebruik van smartphone applicaties maakt het auditieve kanaal een breed potentieel te gebruiken kanaal voor gezondheidsoverreding. Echter, er is relatief weinig bekend over hoe en of auditieve informatie effectief is. In dit proefschrift is onderzocht hoe gezondheidsinformatie met betrekking tot groente- en fruitconsumptie het meest effectief kan worden gecommuniceerd via het auditieve kanaal.

In Hoofdstuk 2 worden twee studies beschreven met betrekking tot algemene processen in auditieve gezondheidsoverreding. In Hoofdstuk 3, 4, 6, en 7 van dit proefschrift worden daarnaast verschillende relevante parameters van auditieve gezondheidsoverreding onderzocht, oftewel, de condities waaronder auditieve gezondheidsinformatie kan leiden tot gedragsverandering. Twee typen parameters worden onderscheiden: condities ten aanzien van de gedragsveranderingsmethode, en individuele verschillen tussen de ontvangers. De condities ten aanzien van de methode refereren aan de manier waarop de overredende auditieve gezondheidsinformatie kan worden gecommuniceerd, zoals het niveau van intonatie van de stem van de spreker (Hoofdstuk 3), het gebruik van achtergrondmuziek (Hoofdstuk 4), kennis over de bron van de informatie (Hoofdstuk 6) en de mate waarin de informatie zelf-refererend is (Hoofdstuk 7). De individuele verschillen die worden getoetst zijn de mate van betrokkenheid (een maat van persoonlijke relevantie, geoperationaliseerd als de eigen ervaren gezondheid of als de waarde die wordt gehecht aan gezondheid) en de inschatting van zelf-effectiviteit. In het kader van het huidige onderzoek vormen de bevindingen ten aanzien van de parameters een leidraad in de ontwikkeling van een samengestelde auditieve smartphone applicatie interventie (de ‘Groente & Fruit hAPP’) om de consumptie van groente en fruit te stimuleren. De effectiviteit van deze computer-getailorde interventie is getoetst in Hoofdstuk 8: Daarin wordt een RCT met een 6 maanden follow-up gerapporteerd waarin een auditieve en een tekstuele smartphone applicatie met elkaar

en met een controle conditie worden vergeleken. Hoofdstuk 5 beschrijft ook de vergelijking tussen tekstuele en auditieve overreding, maar dan in een meer fundamentele studie.

Ten eerste hebben we ons in **Hoofdstuk 2** gericht op processen die binnen auditieve gezondheidsoverreding een rol kunnen spelen. Er werd specifiek onderzocht hoe de perceptie van de betrouwbaarheid van de bron tot stand komt. Op basis van het horen van de stem van de spreker bleek uit de eerste (vragenlijst-) studie (N = 271) dat mensen in staat zijn om de betrouwbaarheid van de spreker in te schatten. Deze indruk hing samen met waarnemingen ten aanzien van de stem (met name de mate waarin de stem als plezierig werd beschouwd) en kenmerken van de persoon (zoals de mate waarin gelijkheid werd ervaren aan de spreker). Daarnaast bleek dat de percepties van intonatie en snelheid van spreken samenhangen met waargenomen persoonskenmerken, die vervolgens gerelateerd zijn aan de waargenomen betrouwbaarheid van de bron. Uit de tweede (experimentele) studie (N = 100) bleek dat de waargenomen betrouwbaarheid van de bron ook door contextuele factoren wordt beïnvloed: Een positieve framing van de auditieve boodschap, een door zelf-affirmatie geïnduceerde “mentale openheid”, en de overeenkomst in geslacht tussen de luisteraar en de bron bleken tot een hoger ervaren betrouwbaarheid van de bron te leiden. Daarnaast is gevonden dat de ervaren betrouwbaarheid van de bron niet altijd samenhangt met de mate van overreding, gemeten als de intentie om de groente- en fruitconsumptie te verhogen. Concluderend kan worden gesteld dat inschattingen van kenmerken van de stem een rol spelen in auditieve communicatie, aangezien deze waarnemingen als basis kunnen dienen om een beeld van de bron van de boodschap te construeren.

In **Hoofdstuk 3** hebben we ons vervolgens gericht op het niveau van intonatie van de spreker als conditie ten aanzien van de auditieve overredende gezondheids-informatie. Intonatie is een belangrijk aspect van stem en spraak waardoor aanvullende informatie kan worden meegegeven in een auditieve boodschap. Door middel van twee experimentele studies onder studenten is onderzocht of het niveau van intonatie van de spreker van invloed is op de mate van overreding, en of een hoog niveau van intonatie voor sommige respondenten tot defensiviteit kan leiden. Overreding is wederom geoperationaliseerd als de intentie om de huidige groente- en fruitconsumptie te verhogen. In Studie 1 (N = 130) luisterden respondenten naar een gezondheids-boodschap met een laag, gemiddeld, of hoog niveau van intonatie. In Studie 2 (N = 143) werden respondenten blootgesteld aan dezelfde manipulaties van intonatie, maar bij de helft van de respondenten werd nu een zelf-affirmatieprocedure toegepast om de mogelijke defensiviteit te onderzoeken. De resultaten laten consistent zien dat intonatie gerelateerd is aan de intentie tot het verhogen van de groente- en fruitconsumptie en dat de betrokkenheid van de luisteraar van invloed is: Het luisteren naar de boodschap

met een hoog niveau van intonatie leidt bij mensen met een goede ervaren gezondheid tot minder overreding. Door de zelf-affirmatieprocedure kon deze daling voorkomen worden, wat suggereert dat de lage overreding een defensieve reactie is op de auditieve informatie gesproken met een hoog niveau van intonatie. De intonatie zorgt er mogelijk voor dat de overredende uitkomsten in de boodschap saillanter worden, wat de dreiging van die uitkomsten groter maakt. Mensen met een goede ervaren gezondheid zijn waarschijnlijk minder gemotiveerd om te investeren in gedragsverandering, omdat zij minder mogelijkheid tot verbetering zullen zien. In het domein van gezondheid is het belangrijk om rekening te houden met dit effect en in het kader van de ontwikkeling van de interventie wordt aanbevolen om gezondheidsinformatie toe te passen met een gemiddeld niveau van intonatie.

In **Hoofdstuk 4** werd het gebruik van achtergrondmuziek bij een auditieve overredende boodschap in een experimentele studie (N = 146) onderzocht als tweede conditie ten aanzien van de auditieve gezondheidsinformatie. Dit onderzoek werd eveneens uitgevoerd onder studenten. Het ging hierbij om de vraag of het toevoegen van achtergrondmuziek aan een auditieve gezondheidsboodschap tot een verhoogde intentie tot gedragsverandering zou leiden en door welke processen dit eventueel verklaard zou kunnen worden (identificatie, stemming of afleiding). Er is gekeken of achtergrondmuziek die bij de identiteit van de luisteraar paste de overreding zou ondersteunen en of achtergrondmuziek die juist niet bij iemands identiteit paste de overreding zou afremmen. Ook was er een conditie waarin achtergrondmuziek werd aangeboden waarvan bekend is dat die de stemming positief beïnvloedt, en er was een conditie zonder achtergrondmuziek. Er werd verwacht dat respondenten met een relatief lage betrokkenheid het meest beïnvloed zouden worden door de verschillen in achtergrondmuziek.

Het belangrijkste resultaat is dat bij mensen met een relatief lage betrokkenheid, lage scores op de intentie tot gedragsverandering werden gevonden na de auditieve boodschap, onafhankelijk van de achtergrondmuziek die al dan niet bij hun identiteit paste. De mate van identificatie met de achtergrondmuziek lijkt dus weinig invloed te hebben op overreding. Na het luisteren naar de gezondheidsboodschap zonder achtergrondmuziek was de intentie bij deze groep zelfs significant hoger. Het lijkt er op dat mensen die gezondheid geen topprioriteit geven de condities met muziek aangrijpen als afleiding van de overredende tekst, die immers tot een waardenconflict leidt. Deze mensen zijn waarschijnlijk niet of nauwelijks gericht op het verbeteren van hun gezondheidsgedrag en kunnen defensief reageren op overredende informatie op dit gebied. Een gezondheidsboodschap met achtergrondmuziek zal dus op een voorzichtige manier toegepast moeten worden. In het kader van onze interventie kan het beste worden gekozen voor een boodschap zonder achtergrondmuziek.

Overredende gezondheidsboodschappen kunnen op verschillende manieren worden gepresenteerd, bijvoorbeeld via de visuele of de auditieve communicatiemodus (als een tekst of als een audio-fragment). De visuele en auditieve communicatiemodus kunnen verschillen in de mate waarin er mogelijkheden zijn om zelfregulatie toe te passen naar aanleiding van de overredende informatie. Als de informatie bedreigend is kan men bij het lezen van een tekst bijvoorbeeld met oogbewegingen de aandacht verleggen naar minder bedreigende delen van de tekst, terwijl men bij auditief aangeboden informatie (waarbij de bron met diens stem op de voorgrond staat) gemakkelijk de bron aan kan vallen, door deze bijvoorbeeld af te doen als ondeskundig. In **Hoofdstuk 5** is het effect van deze zelfregulatie mogelijkheden op de relatie tussen intentie en gedrag onderzocht in een laboratorium experiment. Intentie is direct na blootstelling aan de gezondheidsboodschap gemeten, en de gerapporteerde groente- en fruitconsumptie werd twee weken later vastgesteld. Studenten (N = 128) werden blootgesteld aan een auditieve of tekstuele gezondheidsboodschap, of aan een boodschap die werd aangeboden als een stream tekst, waarbij de inhoudelijke informatie in fragmenten werd getoond, en er om de twee seconden een nieuw fragment van een aantal woorden werd aangeboden. We verwachtten dat deze laatste conditie minder mogelijkheden tot zelfregulatie met zich mee brengt vergeleken met een auditieve of tekstuele boodschap.

De resultaten laten zien dat intentie (zoals direct na de blootstelling gemeten) en gedrag (twee weken later gemeten) alleen met elkaar samenhangen nadat respondenten aan de stream tekst waren blootgesteld: Alleen in deze conditie werd een lage intentie onmiddellijk na de blootstelling ook omgezet in een lage groente- en fruitconsumptie. De relatie tussen intentie en gedrag lijkt af te hangen van de mate waarin er “externe” bronnen voor zelfregulatie voorhanden waren tijdens de blootstelling aan de overredende informatie. Daarnaast bleek dat hoewel de auditieve informatie beter werd onthouden, er geen verschillen tussen de auditieve en tekstuele gezondheidsboodschap werden gevonden op gedrag.

Hoofdstuk 6 beschrijft een laboratorium experiment om meer inzicht te krijgen in het toepassen van een volgende conditie ten aanzien van de auditieve gezondheidsinformatie, namelijk informatie over de bron van de gezondheidsinformatie. Studenten (N = 147) luisterden naar een auditieve gezondheidsboodschap over groente- en fruitconsumptie waarin een vrouwelijke stem zichzelf introduceerde met haar naam en beroep. Er waren vier condities waarin de bron zich introduceerde (als huisarts, voedingswetenschapper, medewerker van het Voedingscentrum of student) en een controle conditie zonder introductie.

Op de intentie direct gemeten na de blootstelling aan de boodschap werden geen significante verschillen gevonden tussen de condities. Er werd ook geen hoofdeffect gevonden op gedrag na twee weken, maar er werd een marginaal significant interactie-

effect gevonden: Respondenten die gezondheid als topprioriteit ervaren rapporteerden de hoogste groente- en fruitconsumptie wanneer de bron zichzelf als huisarts introduceerde. Omdat de informatie in lijn is met hun belangrijkste waarde in het leven, reageren zij waarschijnlijk positief op de informatie zoals gecommuniceerd door deze bron. Respondenten die gezondheid niet als een topprioriteit waarderen leken niet gemotiveerd om te investeren in gedragsverandering, geïllustreerd door de lage scores op gedrag nadat de bron zichzelf introduceerde als huisarts. Deze groep rapporteerde juist de hoogste groente- en fruitconsumptie nadat zij hebben geluisterd naar de student als bron van de informatie. Op basis van deze gegevens kan er een definitieve keuze gemaakt worden over de manier waarop informatie over de bron toegepast moet worden in de auditieve gezondheidsinterventie; een gezondheidsboodschap zonder introductie van de bron wordt aanbevolen.

In **Hoofdstuk 7** staat vervolgens de laatste conditie ten aanzien van de auditieve overredende gezondheidsinformatie centraal, namelijk de mate waarin deze informatie zelf-refererend is. Dit is getoetst in een experimentele studie onder studenten (N = 112) door het effect van *tailoring* van auditieve gezondheidsoverreding te onderzoeken. Er zijn drie ingrediënten van *tailoring* getoetst: Respondenten luisterden ofwel naar een gezondheidsboodschap met feedback op de eigen groente- en fruitconsumptie, naar een gepersonaliseerde gezondheidsboodschap waarin drie keer de voornaam van de respondent werd genoemd, of naar een gezondheidsboodschap die was aangepast aan de belangrijkste waarde van de respondent. Ten slotte was er een controle conditie waarin respondenten naar een algemene gezondheidsboodschap luisterden. Intentie (gemeten direct na blootstelling aan de boodschap) en groente- en fruitconsumptie (twee weken later) waren de afhankelijke variabelen.

Het geven van feedback leidde tot de hoogste intentie tot gedragsverandering. Daarnaast was de betrokkenheid van de respondent wederom belangrijk: De boodschap met feedback was het meest effectief voor respondenten die hun eigen gezondheid als relatief slecht inschatten, terwijl de gepersonaliseerde gezondheidsboodschap tot een significant lagere intentie leidde in deze groep. Respondenten die hun eigen gezondheid als relatief goed inschatten lieten geen verschillen zien tussen de condities. Op gedrag kon deze bevinding niet worden gerepliceerd. In plaats daarvan bleek de inschatting van de eigen effectiviteit van belang te zijn: Alleen respondenten die het moeilijk vonden om voldoende groente en fruit te gaan eten lieten verschillen tussen de condities zien. Na het luisteren naar de gepersonaliseerde boodschap werd de hoogste groente- en fruitconsumptie gevonden in deze groep. Wellicht heeft de auditieve personalisatie bij deze groep met een lage waargenomen zelfeffectiviteit tot een zodanig sterke dreiging geleid dat deze motiveerde om te investeren in gedragsverandering. De manipulatie waarin de auditieve boodschap was geadapteerd (aangepast aan een belangrijke

waarde) had geen effect en is waarschijnlijk mislukt. Concluderend kan er gesteld worden dat *tailoring* onder sommige omstandigheden tot een hogere groente- en fruitconsumptie kan leiden in auditieve gezondheidscommunicatie. Feedback lijkt het meest krachtig te zijn, terwijl de personalisatie voor sommigen beter, maar voor anderen juist slechter is. In de interventie kunnen feedback en een verbeterde adaptatie worden toegepast.

Op basis van bovenstaande bevindingen kunnen we concluderen dat auditieve gezondheidsinformatie onder sommige voorwaarden effectief kan zijn in het stimuleren van groente- en fruitconsumptie. Door deze studies hebben we meer inzicht gekregen in een aantal processen die een rol spelen bij auditieve gezondheidsoverreding. Bij de ontwikkeling van de smartphone applicatie zijn de ervaringen en bevindingen uit deze studies meegenomen.

In **Hoofdstuk 8** is ten slotte in een gerandomiseerd veldexperiment (N = 146) onderzocht of een complexe smartphone applicatie die ontwikkeld is om de groente- en fruitconsumptie te stimuleren effectief is. Hierbij is specifiek gekeken naar de effectiviteit van tekstuele en auditieve gezondheidsinformatie. De afhankelijke variabele is de gerapporteerde groente- en fruitconsumptie na zes maanden. In één versie van de applicatie werden de respondenten maandelijks blootgesteld aan auditieve gezondheidsinformatie op maat, en in een andere versie werd deze informatie tekstueel aangeboden. Daarnaast omvatte de applicatie vaste onderdelen, zoals recepten en voorlichting over verschillende soorten groente en fruit. Naast de twee interventie condities was er een controle conditie waarin geen gezondheidsinformatie werd aangeboden, maar waarin respondenten werd gevraagd om alleen op de voormeting en op de nameting zes maanden later een vragenlijst in te vullen.

De resultaten na zes maanden laten zien dat de auditieve app tot een significant hogere fruitconsumptie leidde; hoger dan de tekstuele app en hoger dan de controle conditie. Dit effect werd daarnaast met name gevonden in respondenten die hun eigen gezondheid als relatief slecht inschatten. Deze respondenten zijn mogelijkerwijs gemotiveerd om te investeren in gedragsverandering. Als het gaat om groenteconsumptie bleek dat beide versies van de app tot een hogere groenteconsumptie leidden, maar alleen bij de mensen die over het algemeen weinig moeite hebben met het begrijpen van informatie over hun gezondheid. Zij rapporteerden de laagste groenteconsumptie in de controle conditie, terwijl voor mensen die over het algemeen moeite hebben met het begrijpen van gezondheidsinformatie de hoogste groenteconsumptie werd gerapporteerd in de controle conditie: Er werd zelfs een significant lagere groenteconsumptie gevonden in beide interventiecondities. De moderatoranalyse legde zo dus een ongewenst effect van de interventie bloot. Samenvattend kan gesteld

worden dat een app waarin auditieve gezondheidsinformatie op maat wordt aangeboden kan leiden tot gedragsverandering na zes maanden. De effecten waren vooral te vinden bij specifieke groepen mensen en verschilden voor groenteconsumptie en voor fruitconsumptie. Dit suggereert dat er gedeeltelijk andere psychologische processen aan deze gezondheidsgedragingen ten grondslag liggen. Ten slotte is het van belang om uit te zoeken waarom sommige groepen geen baat hadden bij de app of zelfs een lagere groenteconsumptie rapporteerden.

Tegenwoordig is het luisteren naar auditieve gezondheidsinformatie (met bijvoorbeeld een virtuele coach) een wijdverspreid fenomeen, waarover nog niet veel bekend is. De bevindingen in dit proefschrift hebben meer inzicht gegeven in processen bij auditieve gezondheidsoverreding en zijn essentieel geweest in de ontwikkeling van een auditieve smartphone applicatie. Naar ons weten is de RCT zoals gepresenteerd in Hoofdstuk 8 de eerste test van effectiviteit van een gezondheidsapplicatie met resultaten op gedrag, in dit geval groente- en fruitconsumptie.

In verschillende studies zijn condities geïdentificeerd waaronder auditieve gezondheidsinformatie kan leiden tot gedragsverandering; het is dus niet altijd en voor iedereen effectief. Het is daarom belangrijk om rekening te houden met de relevante parameters zoals getoetst in het huidige onderzoek. Toekomstig onderzoek kan erop gericht zijn om het proces van auditieve gezondheidscommunicatie verder te optimaliseren, door bijvoorbeeld te zoeken naar manieren om een meer interactieve uitwisseling van informatie te bewerkstelligen. Ook is het van belang om te onderzoeken hoe kwetsbare groepen kunnen worden gestimuleerd om hun gezondheidsgedrag te verbeteren.

Appendices

Appendices

Appendix 1

Transcripts of the health messages as used in the empirical chapters of the current thesis

a) Transcript of the positively framed message (237 words)

as used in Chapter 2 and Chapter 3

Wat je eet, is van invloed op hoe gezond je bent. Vooral het eten van voldoende groente en fruit draagt bij aan een goede gezondheid. Dit blijkt uit een onderzoek van de Universiteit van Maastricht uit 2007. Een voedingspatroon met genoeg groente en fruit bevat voldoende vitamines en mineralen. Dit leidt tot een lagere bloeddruk en een lager cholesterol. Het eten van voldoende groente en fruit leidt zo tot een kleinere kans op hart-en vaatziekten. Daarnaast leidt het tot een betere conditie. Iemand die regelmatig groente en fruit eet, krijgt namelijk voldoende anti-oxidanten binnen, zoals bètacaroteen, vitamine C en vitamine E. Deze stoffen spelen een belangrijke rol bij alle processen waarbij zuurstof wordt verbruikt, dus ook bij lichamelijke inspanning. Verder blijkt uit wetenschappelijk onderzoek dat het eten van voldoende groente en fruit tot een kleinere kans op kanker leidt. Dat komt onder andere doordat de anti-oxidanten de werking van de zogenaamde vrije radicalen tegengaan. Dat is óók de reden waarom mensen er gezonder uit zien als ze voldoende groente en fruit eten: minder vrije radicalen betekent minder veroudering en dus een gezondere huid en gezonder haar. Daarnaast heeft de Rijksuniversiteit Groningen in 2005 onderzoek gedaan naar de relatie tussen groente- en fruitconsumptie en concentratievermogen. Hieruit blijkt dat studenten zich door het eten van voldoende groente en fruit, makkelijker kunnen concentreren bij mentale inspanning (zoals tentamens). Deze effecten van groente en fruit zijn onafhankelijk van erfelijkheid en omgevingsfactoren.

b) Transcript of the negatively framed message (242 words)

as used in Chapter 2, Chapter 4, and Chapter 5

Wat je eet, is van invloed op hoe gezond je bent. Vooral het eten van onvoldoende groente en fruit draagt bij aan een slechte gezondheid. Dit blijkt uit een onderzoek van de Universiteit van Maastricht uit 2007. Een voedingspatroon met te weinig groente en fruit bevat onvoldoende vitamines en mineralen. Dit leidt tot een hogere bloeddruk en een hoger cholesterol. Het eten van onvoldoende groente en fruit leidt zo tot een grotere kans op hart-en vaatziekten. Daarnaast leidt het tot een slechtere conditie. Iemand die te weinig groente en fruit eet, krijgt namelijk onvoldoende anti-oxidanten binnen, zoals bètacaroteen, vitamine C en vitamine E. Deze stoffen spelen een belangrijke rol bij alle processen waarbij zuurstof wordt verbruikt, dus ook bij lichamelijke inspanning. Verder blijkt uit wetenschappelijk onderzoek dat een tekort aan groente en fruit tot een grotere kans op kanker leidt. Dat komt onder andere doordat de anti-oxidanten dan de werking van de zogenaamde vrije radicalen niet tegengaan. Dat is óók de reden waarom mensen er minder gezond uit zien als ze onvoldoende groente en fruit eten: meer vrije radicalen betekent meer veroudering en dus een ongezonde huid en ongezonder haar. Daarnaast heeft de Rijksuniversiteit Groningen in 2005 onderzoek gedaan naar de relatie tussen groente- en fruitconsumptie en concentratievermogen. Hieruit blijkt dat studenten door het eten van onvoldoende groente en fruit, meer moeite hebben zich te concentreren bij mentale inspanning (zoals tentamens). Deze effecten van groente en fruit zijn onafhankelijk van erfelijkheid en omgevingsfactoren.

c) Transcript of the stream text (negatively framed message; 74 clusters of words)

as used in Chapter 5

Wat je eet / is van invloed op / hoe gezond je bent. / Vooral het eten van / onvoldoende groente en fruit / draagt bij aan / een slechte gezondheid. / Dit blijkt uit / onderzoek van / de Universiteit van Maastricht uit 2007. / Een voedingspatroon met / te weinig groente en fruit / bevat onvoldoende / vitamines en mineralen. / Dit leidt tot / een hogere bloeddruk / en een hoger cholesterol. / Het eten van / onvoldoende groente en fruit / leidt zo / tot een grotere kans op / hart- en vaatziekten. / Daarnaast / leidt het tot / een slechtere conditie. / Iemand die / te weinig groente en fruit eet, / krijgt namelijk / onvoldoende anti-oxidanten binnen, / zoals bèta-caroteen, / vitamine C en / vitamine E. / Deze stoffen / spelen een belangrijke rol / bij alle processen / waarbij zuurstof wordt verbruikt, / dus ook bij lichamelijke inspanning. / Verder blijkt uit / wetenschappelijk onderzoek / dat een / tekort aan groente en fruit / tot een grotere kans op / kanker leidt. / Dat komt onder andere / doordat de anti-oxidanten dan / de werking van / zogenaamde vrije radicalen / niet tegengaan. / Dat is óók / de reden waarom mensen / er minder gezond uit zien / als ze / onvoldoende groente en fruit eten: / meer vrije radicalen betekent / meer veroudering / en dus / een ongezonde huid / en ongezonder haar. / Daarnaast heeft de Rijksuniversiteit Groningen in 2005 / onderzoek gedaan / naar de relatie / tussen groente- en fruitconsumptie / en concentratievermogen. / Hieruit blijkt dat studenten / door het eten van / onvoldoende groente en fruit, / meer moeite hebben / zich te concentreren / bij mentale inspanning / (zoals tentamens). / Deze effecten van groente en fruit / zijn onafhankelijk van / erfelijkheid en omgevingsfactoren.

d) Transcript of the combined positive and negative framing message (302 words)

as used in Chapter 6

Including source introduction sentences:

1) Mijn naam is Marieke van Dijk en ik ben werkzaam bij het Voedingscentrum.
2) Mijn naam is Marieke van Dijk en ik ben huisarts.
3) Mijn naam is Marieke van Dijk en ik ben voedingswetenschapper.
4) Mijn naam is Marieke van Dijk en ik ben student.

Ik wil je wat vertellen over het eten van groente en fruit. Wat je eet is van invloed op hoe gezond je bent. En het eten van voldoende groente en fruit draagt bij aan een goede gezondheid en het voorkomen van ziekte. Uit onderzoek van de universiteit van Maastricht blijkt dat de consumptie van voldoende groente en fruit tot een betere weerstand leidt; dus minder vaak griep en verkoudheid. Groente en fruit bevatten vitamines en mineralen. Die zijn hard nodig voor een goede bloeddruk en het tegengaan van een hoog cholesterol. En het eten van voldoende groente en fruit leidt zo tot een kleinere kans op hart- en vaatziekten. Ook is groente- en fruit consumptie gerelateerd aan de conditie. Iemand die onvoldoende groente en fruit eet, krijgt namelijk niet genoeg anti-oxidanten binnen, zoals bètacaroteen, vitamine C en vitamine E. Deze stoffen spelen een belangrijke rol bij alle processen waarbij zuurstof wordt verbruikt, dus ook bij lichamelijke inspanning. Verder blijkt uit wetenschappelijk onderzoek dat voldoende groente en fruit tot een kleinere kans op kanker leidt. Ja, en dat komt onder andere doordat de anti-oxidanten de werking van de zogenaamde vrije radicalen tegengaan. Dat is óók de reden waarom mensen er ongezonder uit gaan zien als ze onvoldoende groente en fruit eten: meer vrije radicalen betekent meer veroudering en dus een ongezondere huid en ongezonder haar. En daarnaast kunnen groente en fruit bijdragen aan een gezond lichaamsgewicht, en daarmee aan een kleinere kans op diabetes. De Rijksuniversiteit Groningen heeft onderzoek gedaan naar de relatie tussen groente- en fruitconsumptie en concentratievermogen. En hieruit blijkt dat men zich door het eten van voldoende groente en fruit beter kan concentreren bij mentale inspanning, wat van belang kan zijn bij taken in het dagelijks werk. Al deze effecten van groente en fruit bestaan zelfs onafhankelijk van erfelijkheid en omgevingsfactoren.

e) Transcript of the generic message (223 words)

as used in Chapter 7

Wat mensen eten is van invloed op hoe gezond ze zijn en hoe energiek ze zich voelen. Vooral het eten van voldoende groente en fruit draagt bij aan een goede gezondheid. Ze bevatten vitaminen, mineralen en voedingsvezels. Ons lichaam heeft deze voedingsstoffen nodig om goed te kunnen functioneren: het is écht een basisbehoefte. De gezonde voedingsstoffen hebben verschillende positieve effecten voor je gezondheid, zowel op lange als op korte termijn. Zo zorgt vitamine C voor een hogere weerstand met als gevolg dat je minder vaak ziek bent. Daarnaast zorgt het mineraal kalium uit groente en fruit voor een lagere bloeddruk, wat je hart en bloedvaten beschermt. Dus door genoeg groente en fruit te eten, heb je een verlaagd risico op hart- en vaatziekten. Onderzoek toont daarnaast aan dat groente en fruit mogelijk de kans op bepaalde vormen van kanker verkleint. Verder dragen voedingsvezels uit groente en fruit bij aan een gezonde darmwerking en zorgen ze voor een verzadigd gevoel. Daardoor krijg je minder snel trek in iets anders en zo helpen groente en fruit om een gezond gewicht te behouden. Daarnaast ruikt fruit lekker en heeft het een heerlijke frisse smaak. Het eten van voldoende groente en fruit is tegenwoordig ook erg gemakkelijk. Dus voldoende groente en fruit eten hoeft niet veel moeite te kosten en het draagt bij aan een gezonde leefstijl.

Appendix 2

QR-codes of the auditory health messages to give an impression of the stimuli used in the empirical chapters of the current thesis

Chapter 2 **QR-code 1:**
Female voice I, positive frame (Study 1 & 2)

QR-code 2:
Male voice I, negative frame (Study 2)

Chapter 3 **QR-code 3:**

Female voice I, positive frame (Study 1 & 2)
Low level of intonation

Moderate level of intonation (see QR-code 1)

QR-code 4:

High level of intonation

Chapter 4 **QR-code 5:**

Female voice I, negative frame, background music (positive identification example)

Chapter 5 **QR-code 6:**

Female voice I, negative frame, high level of intonation

Chapter 6 **QR-code 7:**

Female voice II, positive and negative frame, example of a source (physician)

Chapter 7 **QR-code 8:**
Female voice III, generic message

QR-code 9:
Female voice III, example of an applied tailoring ingredient (personalization)

Chapter 8 **QR-code 10:**
Female voice III, example of a health message at T1, composed of 11 parts of information

Acknowledgements (Dankwoord)

Dankwoord

De afgelopen tijd heb ik mij met een mooi en intrigerend onderwerp mogen bezighouden. Ik kwam er bijvoorbeeld achter dat een stem kan raken en kleur kan geven, zowel in de context van dit proefschrift als in het dagelijks leven. Er zijn veel mensen geweest die de afgelopen jaren voor mij kleur hebben gegeven, die er voor me waren en die ik hieronder graag wil bedanken voor hun luisterend oor en meer.

Ten eerste, Arie, bedankt voor je vertrouwen, voor je oog voor detail en dat je deur altijd voor me open staat. Het is voor mij erg inspirerend hoe jij theoretische invalshoeken vertaalt naar concrete voorbeelden. Jouw positieve en oplossingsgerichte manier van denken en doen heeft mij heel erg geholpen. Ook wil ik je bedanken voor je begrip en geduld en voor het feit dat je in moeilijke perioden altijd eerst vroeg naar hoe het met mij ging, en pas daarna naar het project informeerde. Onze samenwerking duurt nog even voort, en ik kijk uit naar deze nieuwe fase.

Renger Koning en Marianne Bakker van studio Soundbase, dank voor de professionele samenwerking door de jaren heen en voor het maken van de vertaalslag naar mijn onderzoek (bijvoorbeeld toen ik vroeg of de teksten ook op een niet-geacteerde manier konden worden ingesproken). Bedankt ook voor jullie flexibiliteit en alle hulp naderhand wanneer ik om kleine aanpassingen vroeg. Liesbeth, Leonieke, Roel en Saskia wil ik bedanken voor het inspreken van de verschillende teksten over groente en fruit, zonder jullie stem en inzet was er helemaal geen onderzoek geweest.

Jaap, Wilmer en Robbert; bedankt voor al jullie hulp en technische ondersteuning bij het ontwikkelen en eindeloos testen van de interventie. Dank voor onze reeks van groente en fruit afspraken op woensdagochtend en het feit dat ik altijd binnen kon (en kan) lopen voor een vraag over een update, beslissingsregel of ander technisch iets. In mijn ogen was het door deze uitgebreide technische ondersteuning (waarvoor ik maar een paar trappen naar beneden hoefde te lopen) goed mogelijk om onze smartphone app te ontwikkelen. Dank daarvoor!

Tijdens een gedeelte van mijn project heb ik twee fantastische onderzoeks-assistenten gehad. Michèle, heel erg bedankt voor je enthousiasme en je logistieke ondersteuning bij het uitvoeren van de muziek-studie. Andrea, dankjewel ook voor je enthousiasme en je inzet voor verschillende studies tijdens het tweede deel van mijn project; jij zorgde er voor dat het niet volledig stil kwam te staan. Ook bedankt voor je

input met betrekking tot de tailoring-studie, zowel tijdens het opzetten van het onderzoek als bij het schrijven van het paper.

Hannique, dankjewel voor de mooie vormgeving van mijn proefschrift en onze fijne samenwerking.

Mijn lieve paranimfen wil ik bedanken; Nicole, dankjewel dat ik je heb leren kennen (al kunnen we ons er nog over verbazen waarom we dat niet eerder hebben gedaan). Nog meer dankjewel voor je vriendschap en de lol die we samen hebben! Debby, dank voor je vriendschap door de jaren heen, en voor de vrolijkheid en rust die je uitstraalt. Dankjulliewel allebei dat jullie naast me willen staan als paranimf, dat betekent veel voor me!

Mijn kamergenootjes; Marlon, dank voor de gezellige en fijne tijd die we hebben gehad. Ik heb jullie soms wat aangedaan met het inspreken van teksten over groente en fruit, bétacaroteen en vitamine C: dank dat dat kon! Bart, ik wil je ook bedanken voor het zijn van een geweldige collega, maar nog meer voor de fijne momenten die we buiten het werk hebben gedeeld, je openhartigheid en je echtheid. Zodra je was verhuisd uit Groningen miste ik de pubquiz-avondjes en andere gezelligheid al! Thecla, dankjewel dat je mijn kamergenoot bent, met wie ik inzichten kan delen, hard kan werken, kan kletsen en kan zuchten. Het delen van de kleine dingen kan soms juist zo helpen en opluchten, dankjewel daarvoor.

Al mijn 'Health' collega's: Yvonne, Karin, Judith, Thecla, Simon, Adrie, Karlien, Maaike, Sjoukje, Ari, Yingqiu, & Lonneke. Dank jullie wel voor jullie feedback en gezelligheid door de jaren heen, ik heb daar veel aan gehad! Rixt, jij ook heel erg bedankt voor je enthousiasme en onze gesprekken naderhand.

Anne Fetsje, Ellen, Namkje, Ruth, Lise en Elanor, alias de Giraffen en Zebra's! Dankjulliewel voor alle gezelligheid en lol, bijvoorbeeld tijdens borrels na het werk of bij het maken van goeie promotie-filmpjes. Ik vind het fijn dat we zo af en toe nog contact hebben! Hedy, Iris, Leonie, Cobus, en Berfu, bedankt voor vele gezellige momenten en fijne gesprekken! Een speciaal dankjewel ook voor collega's die een tekst hebben ingesproken als fruitliefhebber, groenteman, diëtiste of huisarts voor in de smartphone app: Anne Marthe, Nicole, Elanor, Joringel, Cobus, Ruth, Jaap, Leonie, Gert, Thijs, Anne Fetsje en Wiebren. Verder wil ik natuurlijk al mijn collega's van de vierde verdieping bedanken voor jullie inbreng, de inspiratie en gezelligheid, in welke vorm dan ook! Ook alle collega's van de docenteneenheid; bedankt voor de lol tijdens BBQ en borrel en het vormen van een fijne groep. Ook de

portiers en dames van het secretariaat, dankjulliewel voor jullie ‘goedemorgen’ en alle ondersteuning.

Dank ook aan mijn lieve vriendinnen, die voor mij synoniem staan voor gezelligheid, borrels, dansjes en mooie gesprekken (meestal in een combinatie) door het hele land heen. In willekeurige volgorde, dankjewel Jody, Jantine, Mirjam, Janneke, Evelien, Meike, Margriet, Judith, Karin (Jien), Carolien en Miriam; jullie hebben mij allemaal stuk voor stuk gesteund wanneer het nodig was en met jullie kan ik ook (of vooral) over andere dingen praten dan werk. Daarvoor kan ik jullie eigenlijk niet genoeg bedanken! Boudien en Femke; ik mag jullie dan nog wel niet zo lang kennen, maar ik wil jullie bedanken voor jullie betrokkenheid en de gezelligheid in Sneek!

Mijn hele (schoon)familie; allemaal bedankt voor het familie-zijn en het instant familiegevoel wat jullie me geven, daar geniet ik van. Mijn oma en mijn beppe wil ik graag noemen, ik denk dat jullie trots zijn! Lieselotte, dankjewel voor je enthousiasme over mijn project en de fijne gesprekken die we hebben gehad. Gerda en Gerrit, dankjulliewel voor jullie oprechte interesse in mijn onderzoek, jullie frisse blik en soms kritische vragen (niet tijdens m’n verdediging), voor jullie steun en de fijne afleiding die soms zo welkom was. Eva, samen met Sjoerd dankjewel voor het zijn van mijn zus(je) en zwager. Ook dank voor het lenen van je stem toen je enkele teksten in de studio hebt ingesproken en voor onze gezelligheid, bijvoorbeeld tijdens uitjes met mama en Gerda. Die jurkjes had ik alleen maar met jullie kunnen en willen kopen!

Papa en mama, bedankt voor jullie betrokkenheid, het vragen naar mijn onderzoek en het bijhouden van mijn bezigheden. Voor jullie optimisme en enthousiasme, voor het samen wachten, en voor de aanmoedigingen en bloemen op het juiste moment. Dankjulliewel voor jullie steun, aandacht en liefde bij alles wat er tijdens dit promotietraject voorbij is gekomen en voor alles wat jullie me hebben meegegeven waardoor ik nu ben wie ik ben.

En dan… Joeri. Dankjewel voor je relativeringsvermogen, je vrolijkheid en je liedjes door de dag heen. Voor de lol die we samen hebben, en dat je m’n leven lichter maakt waar nodig. Dankjewel ook voor je betrokkenheid en steun tijdens de lange laatste loodjes van dit proefschrift, maar bovenal voor je liefde met twee armen en het leven dat we samen delen. Wat ben ik blij dat ik je heb leren kennen.

Curriculum Vitae

Curriculum Vitae

Sarah Pietertje Elbert was born in 1987 in Smilde (the Netherlands) and grew up with her parents and sister in 'de Achterhoek'. She started her bachelor studies in Psychology at the University of Groningen, where she obtained her Master's degree in Social Psychology (cum laude) in 2009. During this final year, she did an internship in a sport psychology practice (Mental Training & Coaching Centre), and it was this project that raised her interest in doing (applied) scientific research. In 2009, she started working on her Phd project about auditory health persuasion under supervision of prof. dr. Arie Dijkstra. Currently, Sarah is working as a postdoctoral researcher, in order to discover more about the psychological underpinnings of health behavior change in vulnerable groups. In addition, she is teaching psychology at the University of Groningen.

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